PREFINAL

Environmental Assessment

for

Fort Sam Houston Overall Mission

at

Fort Sam Houston
Texas

United States Army
U.S. Army Medical Command

July 2001

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2050 Worth Road
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EXECUTIVE SUMMARY

This Environmental Assessment (EA), prepared pursuant to the National Environmental Policy Act (NEPA), evaluates the existing and potential environmental and human impacts associated with the current mission of the Fort Sam Houston (FSH) Military Reservation in San Antonio, Texas and the operation of the Canyon Lake Recreation Area (CLRA). The CLRA is a 110-acre facility located 48 miles northeast of FSH on Canyon Lake Reservoir. The facility is permitted to FSH by the U.S. Army Corps of Engineers (USACE) and serves primarily as a recreational facility for military personnel.

This EA analyzes two alternatives. Alternative 1, the No Action Alternative (status quo), would continue the existing mission, with planned, small incremental reductions in personnel and operating budgets for the foreseeable future. An unavoidable consequence of Alternative 1 is that much of the support capacity of FSH, including various historic buildings, would not be used, possibly resulting in damage to or deterioration of cultural resources due to lack of funding.

Under Alternative 2, the Adaptive Reuse of Facilities and Property by Military and Federal Users, existing tenants would reuse currently vacant facilities, plus new military and/or Federal tenants with new missions would be added. This alternative envisions making maximum use of existing facilities and capabilities of FSH, with the attendant benefit of maintaining and rehabilitating historic structures and landscapes that may otherwise deteriorate. Alternative 2 involves a moderate, incremental increase in base population for the foreseeable future.

FSH has traditionally performed five basic roles or missions: headquarters functions, logistical base, garrison, mobilization/training, and medical activities. The overall mission of FSH currently includes several discrete activities: the capacity to function as a major U.S. Army command and control operation; a center for premier medical training facilities; the site of one of the Army's premier medical facilities, Brooke Army Medical Center; a garrison headquarters; a major medical mobilization site for the U.S. Army in the event of a national or regional emergency; and an established military complex that is able to support other unforeseen national contingencies.

Alternative 1, the continuation of the existing mission at FSH, represents a continuation of activities that have been conducted on the base for many years, resulting in no significant adverse impacts to the natural environment. However, the reduction in base population (a loss of 640 persons through 2005) and the reduction in operating budgets has a real potential to result in damage to historical structures and landscapes that would not be properly maintained. Alternative 2, like Alternative 1, involves no significant negative impacts to the natural environment, even though base population would increase slightly (an additional 2,416 persons through 2005). This alternative, however, has the potential for positive impacts on cultural resources through adaptive reuse of existing structures, including maintenance and/or rehabilitation, that might otherwise suffer damage through neglect.

More specifically, neither alternative would significantly impact earth resources, such as geology, soils, and topography, or air quality and noise. Any impacts to geology, soils, and topography would be associated with building demolition and construction activities at FSH, would be temporary and minimal, and could be mitigated through the use of

existing plans and management practices. Significant construction or demolition actions would be subject to separate NEPA analysis.

FSH is in compliance with current Clean Air Act requirements, and the adoption of either alternative would not alter that status. However, steps are being taken at FSH to minimize and mitigate any air emission impacts. Air emissions at FSH are mainly associated with numerous boilers and petroleum dispensing stations. Over the past 15 years, associated air pollution has been reduced through conversion from oil to natural gas and through the use of Stage II vapor recovery systems at large fueling points.

In February 2001, however, the U.S. Supreme Court upheld the EPA's decision to incorporate new health-protective ambient air standards for ground-level ozone and particulate matter. These two standards will now be implemented nationwide. It is unclear what impact these new standards will have on the attainment designations for the region of Texas in which FSH is located. It is very possible, however, that the San Antonio region may become classified as nonattainment for ozone under the new standard. If this occurs, the EPA and the State would have to confer to establish reduction goals and set a time frame for attaining compliance with the new levels. Under these circumstances, FSH would be required to comply with these strict requirements.

Noise impacts associated with on-post traffic occur regularly, but they are considered minor. Occasional helicopter flights, mainly associated with the Brooke Army Medical Center, create noise impacts, but mitigation measures are in place, such as adjusting flight paths to follow major roadways and a noise complaint response program. The moderate increase in base population associated with Alternative 2 would not add measurably to existing noise levels.

No significant adverse impacts are predicted for water resources, including surface water, floodplains, waterways, wetlands, or groundwater. FSH has established a Water Use Reduction Program that includes the use of recycled water from the San Antonio Water System for on-base cooling towers and irrigation. FSH's continued use of the Edwards Aquifer, under either alternative, would be subject to the San Antonio Military Water Working Group's water allocation cap. This annual cap was established in response to a U.S. Fish and Wildlife Service Biological Opinion that came about partly due to litigation concerning several federally listed threatened and endangered species that are jeopardized when the Edwards Aquifer is drawn down below certain levels. FSH's annual draw upon the Edwards Aquifer, under either alternative, would be below the allotted annual cap through 2005, amounting to a positive impact, both on the status of the aquifer and for the protection of endangered and threatened species.

The biological resources at FSH include limited flora and fauna, as well as sensitive areas including wetlands and riparian habitat. Much of the historical natural habitat has been altered as a result of years of urbanization and operation of Fort Sam Houston. The Salado Creek floodplain, which includes wetlands and riparian habitat, has been maintained in a natural condition. Programs under either alternative would continue to protect this sensitive habitat. Any outgrant that would affect the Salado Creek floodplain and its wetlands would be the subject of separate NEPA documentation.

The primary land use impacts associated with either alternative on FSH are the proposals for demolition, disposal, reuse, and construction of facilities on-post. The impacts associated with demolition and disposal, such as noise and dust, would be

temporary and isolated to the immediate area of demolition. Comprehensive planning documents, such as a Real Property Master Plan, a Landscape Master Plan, an Installation Design Guide, and a Cultural Resource Management Plan, would provide guidance that would ensure that aesthetic, cultural, and historic qualities of land uses on-post would be maintained at FSH under either alternative.

In particular, the program to preserve and manage architectural resources is very active. Alternative 1 raises a concern that the combination of vacant historic properties and reduced budgets for maintenance may result in these properties deteriorating, becoming damaged, or being destroyed. Alternative 2, however, envisions the maximum reuse of existing properties, with the attendant benefits of increased budgets to ensure the continued proper management of these properties.

Positive socioeconomic impacts are associated with FSH's continued operation under either alternative. FSH is a significant employer in the San Antonio area and, pursuing its current mission, contributes to an overall positive economic impact in the San Antonio region of about $695 million per year (1999). Under either alternative, this positive economic impact would continue, although Alternative 1, involving a slight decrease in base employment (a loss of 640 personnel through 2005), would result in a minimal reduction in the current positive impact. Under Alternative 2, on the other hand, the moderate increase of personnel (a gain of 2,416 people through 2005) would add minimally to the current positive economic impact.

The current FSH shortfall in available family housing on-post is expected to continue under either alternative. However, FSH is investigating the possibility of "privatizing" family housing under the Military Housing Privatization Initiative (MHPI). Also, through a program known as the Residential Communities Initiative (RCI), the Army may establish long-term business relationships with private developers to improve military housing on base. These initiatives would assist military personnel who currently wait long periods of time for base housing. With or without these initiatives, neither alternative is expected to negatively impact the relatively stable San Antonio housing market.

Neither alternative is expected to have a major impact on utility consumption at FSH as utilities are being privatized. Through ongoing conservation programs, and based on recent statistics, utility usage is forecast to decline in the foreseeable future.

No adverse impacts are anticipated with respect to hazardous materials/hazardous wastes or solid waste management under either alternative. The existing types and volumes of hazardous materials and wastes at FSH are expected to remain essentially constant. FSH maintains effective programs to manage hazardous materials and dispose of wastes. Furthermore, licensed contractors transport and dispose of hazardous and solid waste.

In summary, both alternatives are expected to have similar impacts at FSH, with the exception of impacts on cultural resources. Alternative 2 presents an opportunity to better protect and preserve historic properties at FSH by reusing them. Proper rehabilitation and maintenance under this alternative would prevent a potential for significant loss of historic properties at FSH due to lack of funding under Alternative 1.

Regarding the CLRA, neither alternative involves significant adverse impacts. A construction project is scheduled for the CLRA to build permanent cabins to replace

trailers; however, any negative impacts associated with the construction phase would be temporary and mitigated through the use of established best management practices.

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1.0 INTRODUCTION

1.1 PURPOSE AND NEED

This Environmental Assessment (EA), prepared pursuant to the National Environmental Policy Act (NEPA), evaluates the existing and potential environmental impacts of current and foreseeable mission functions of Fort Sam Houston (FSH), Texas. In general, the overall mission of FSH is to command, operate, and administer the use of the resources of FSH, Camp Bullis (a sub-installation of FSH), and the Canyon Lake Recreational Area (CLRA), which provides recreational opportunities to local military personnel.

This EA focuses on the activities and impacts of the FSH Military Reservation in San Antonio, Texas, and the CLRA, a 110-acre facility permitted to FSH by the U.S. Army Corps of Engineers (USACE) located 48 miles northeast of FSH on Canyon Lake Reservoir. Because there are significant differences between FSH and Camp Bullis, a sub-installation located 18 miles northwest of FSH, both in physical setting and in the types and scale of mission activities conducted at the two installations, a separate EA was prepared to address the impacts of the training activities conducted locally at Camp Bullis (USACE, 1999c). Therefore, this EA does not contain detailed discussions of the impacts associated with the local training activities conducted at Camp Bullis. However, to analyze the impacts of the number of people associated with FSH's mission, this document uses statistical data for personnel loading and relevant populations for FSH as a whole (which may in some cases include Camp Bullis population data). This conservative approach is employed to ensure that, within the Region of Influence (ROI) of FSH, all impacts influenced by the numbers of personnel associated with FSH are assessed, and cumulative impacts within the ROI are properly identified.

NEPA requires Federal agencies to consider the environmental consequences of all proposed actions in their decision-making process. The intent of NEPA is to protect, restore, or enhance the environment through a well-informed decision-making process. The Council on Environmental Quality (CEQ) was established under NEPA to implement and oversee Federal policy in this process. To this end, the CEQ issued the regulations for Implementing the procedural provisions of NEPA (40 CFR 1500-1508). Army Regulation (AR) 200-2 implements the CEQ regulations within the Army. The CEQ regulations and AR 200-2 provide for the periodic review of continuing activities to ensure that previous assessments of setting, actions, and effects remain substantially accurate, particularly if changes in operation have occurred or are planned. Changes during recent years regarding FSH include a change in the overall command structure, the completion of a new major medical facility, shifts in some training operations from FSH to Camp Bullis, demolition of buildings and construction of new facilities, and litigation resulting in new regulations governing the Edwards Aquifer, water use, and endangered species. This document assesses the environmental impacts associated with the selected alternatives for the FSH mission (including the CLRA), in view of changes since the last NEPA assessment was completed in 1991.

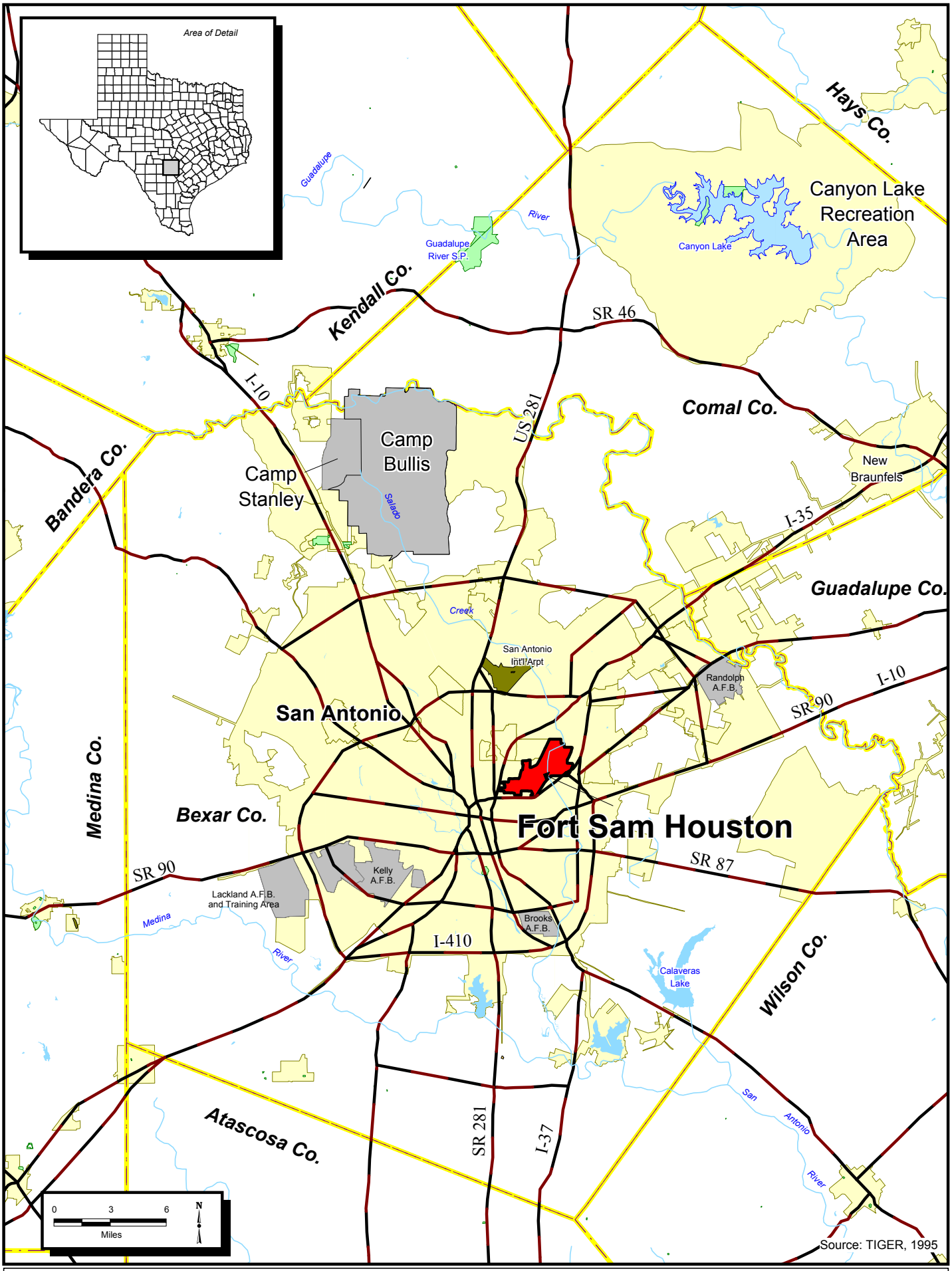


Figure 1-1 -- Fort Sam Houston Locator Map

This EA analyzes environmental effects and mitigation under the NEPA Process to enable the Army to make an informed choice among two mission alternatives: Alternative 1 – the No Action Alternative (or Status Quo); and Alternative 2 – the Adaptive Reuse of Facilities and Property by Military and Federal Users. These two alternatives are further discussed below in Section 2.0, Description of Alternatives.

1.2 BACKGROUND

The military activities that developed into FSH originated in 1845 when the Army came to San Antonio. FSH began operation on rented real estate in San Antonio and has since grown into a modern military installation. Currently, the FSH Military Reservation is located within the city limits of San Antonio, Texas, 2.5 miles northeast of the downtown area. The CLRA is an outdoor recreation area located 48 miles northeast of FSH in the Jacobs Creek area of the Canyon Lake Reservoir. The Reservoir is located north-northwest of the town of New Braunfels, along the Guadalupe River. The CLRA was leased in 1965 from the USACE for a 50-year period for use as a recreational area for FSH personnel (see Figure 1-1).

Today, FSH hosts a variety of tenant activities and supports numerous satellite activities within its assigned geographical installation support area. FSH has traditionally performed five basic roles or missions: headquarters functions, logistical base, garrison, mobilization/training base, and medical activity. It continues in these roles today, although the proportion of installation assets devoted to each mission has changed over time to meet requirements. Overall, FSH and its sub-installations consist of approximately 31,000 acres distributed among the FSH Military Reservation (3,150 acres), the CLRA (110 acres), and the Camp Bullis Military Reservation (27,994 acres). As noted above, Camp Bullis operations are addressed in a separate EA.

In October 1995, the command of FSH shifted from U.S. Army Forces Command (FORSCOM) to Headquarters, U.S. Army Medical Command (MEDCOM), which is physically located at FSH. The overall mission of the installation includes several discrete activities, including the capacity to function as: a major U.S. Army command and control operation; a center for premier medical training facilities; Brooke Army Medical Center (BAMC); a Garrison headquarters providing administrative support for the installation and its tenants; a major mobilization station for the U.S. Army in the event of a national or regional emergency requiring a Reserve call-up; and an established military complex with the capability to support other unforeseen national contingencies. More specifically, current and likely future missions assigned to organizations at FSH support the land force elements within the *U.S. Armed Forces Joint Vision 2010,* developed by the U.S. Joint Chiefs of Staff (USJCS) (USJCS, 1995). Installation activities also support the *Army Medicine Strategic Plan 1999 – 2005* (U.S. Army, 1999). This plan states that medical readiness is the Army Medical Department's reason to exist. Nearly all FSH activities directly impact the nation's ability to maintain and optimize soldier health and fitness and to project a full spectrum of medical services when they deploy.

The daily operations of FSH and its associated properties are diverse and encompass nearly all the activities of a small city, in addition to military training and contingency functions. The broad activities associated with FSH can be categorized into the following eight basic functions: administration and support; construction (including

demolition); operation and maintenance; light industry; research, development, test, and evaluation; medical services; recreation; and training. FSH has prepared a Draft Programmatic Environmental Impact Statement (PEIS) titled *Fort Sam Houston, Camp Bullis, and Canyon Lake Recreation Area Master Plan Programmatic Environmental Impact Statement* (U.S. Army, 2000a), referred to henceforth in this document as the FSH PEIS. Many of the environmental impacts associated with the FSH mission, but focused on or related to the real property master planning process, are discussed and analyzed in that document. Where appropriate, and pursuant to CEQ regulations and AR 200-2, this EA refers to the FSH PEIS and incorporates by reference relevant analysis, discussion, and/or findings. A copy of the PEIS is available for public review at the Fort Sam Houston Public Affairs Office.

The largest organizational occupants of FSH include the U.S. Army Garrison, FSH (Garrison), which provides the headquarters function for the installation itself, and five additional major tenants. Numerous other, smaller tenants and service agencies are located on or supported by the post. The five major tenants are: Headquarters, U.S. Army MEDCOM; BAMC; U.S. Army Medical Department Center and School (AMEDDC&S); Headquarters, Fifth U.S. Army; and Headquarters, U.S. Army 5th Recruiting Brigade.

The Army Stationing and Installation Plan (ASIP) (U.S. Army, 1999a) provides scheduled base personnel loadings for a 6-year period and is updated on an annual basis. While the data series are generally similar, the data for each future year change slightly as the Army's planning cycle progresses. The strength data used in the development of this EA are from the ASIP for fiscal year (FY) 99 to FY 2005, dated 1999. The number of permanently assigned personnel supporting the current FSH mission, including the major commands and smaller tenants, are summarized in Table 1-1, below.

Table 1-1 Fort Sam Houston Permanent Population Profile

FY 1999

MILITARY		**CIVILIAN**	
Officer	2,835	DoD Civilians	5,052
Warrant Officer	94	Other Civilians	2,165
Enlisted	8,232		
Total Military	**11,161**	***Total Civilian***	**7,217**

Total Military/Civilian Population: 18,378

Source: U.S. Army, 1999a. (ASIP)

1.3 PUBLIC INVOLVEMENT

Public participation is a necessary and important component of the NEPA process. In compliance with NEPA, CEQ Regulations, and AR 200-2, a public outreach and involvement plan is in place to make available to the public this assessment of the environmental impacts associated with the overall mission of FSH and the CLRA, and any decisions made based on the analysis. A public notice will be published by the Public Affairs Office (PAO) at FSH alerting the local public that copies of this EA, and the final decisions made using this analysis, are available for review.

In addition, a Memorandum of Understanding (MOU) between the major Department of Defense (DoD) installations in the San Antonio, Texas area, including FSH, and the Alamo Area Council of Governments (AACOG), states that both "the DoD installations and the AACOG are interested in consistency and compatibility of all Federal, State and local plans, programs and projects in the twelve county AACOG region." There follows an agreement that, consistent with military requirements, any plans, programs, and projects of one DoD installation that may affect plans, programs, and projects of other Federal, state, local, or regional agencies will be submitted to the AACOG for review. NEPA documents are specifically noted to be among those types of documents that AACOG will review as part of the standard environmental review process.

1.4 ORGANIZATION OF THIS EA

This EA describes existing environmental conditions and assesses impacts associated with the overall mission activities at FSH and the CLRA. Section 1 outlines the purpose and need for the preparation of this EA, and provides background for the mission activities of FSH. Section 2 describes the existing mission of FSH and identifies two alternatives for analysis. The section discusses in detail the two alternatives used in the environmental impact analysis. Section 3 describes existing conditions at FSH for each of the resource areas analyzed. Section 4 describes environmental consequences and impacts upon these resource areas associated with the alternatives, and discusses mitigation measures, environmental justice issues, and cumulative impacts. Section 5 lists references used to prepare this EA, including documents, personal communications, and correspondence. Section 6 lists the persons preparing or contributing to this document. Appendices, as listed in the Table of Contents, follow Section 6.

2.0 DESCRIPTION OF ALTERNATIVES

2.1 ALTERNATIVES ANALYSIS

In promulgating the NEPA process within the Army, AR 200-2 provides that a consideration of reasonable alternatives is integral to any EA, specifically noting that a No Action Alternative should always be considered. CEQ regulations governing NEPA require examination of all reasonable alternatives, that is, alternatives that "are practical or feasible from the technical and economic standpoint and using common sense" (CEQ: Forty Most Asked Questions Concerning CEQ's NEPA Regulations, 46 CFR 18026, March 23, 1981). This EA analyzes two alternatives: Alternative 1, The No Action Alternative (status quo); and Alternative 2, The Adaptive Reuse of Facilities and Property by Military and Federal Users.

Alternative 1 – The No Action Alternative (status quo) amounts to a continuation of the existing mission, recognizing planned reductions in personnel and projected reductions in base operations (BASEOPS) budgets over the next several years, with a resultant increase in vacancy of existing FSH properties. Alternative 2, identified as the Reuse of Facilities and Property by Military and Federal Users alternative, would involve the continuation of the existing mission with an adaptive reuse of currently vacant existing facilities (including existing historical facilities) by other military or Federal organizations using the existing appropriated funds process. This reuse could include the addition of either military missions or other Federal missions (or a combination thereof) at FSH through individual stationing decisions that take advantage of the capabilities of FSH.

The FSH PEIS (U.S. Army, 2000a), in assessing the FSH master planning process, analyzes a third alternative, Reduction of Underutilized/Unutilized Property Through Lease, Sale or Removal. In analyzing the impacts of the planning process, the FSH PEIS is concerned with the potential impacts associated with the reduction of property alternative, in particular impacts upon cultural resources, but those impacts are not integral to the conduct of the military installation's mission, which is the subject of this EA. This EA, which focuses on the overall mission of FSH and the CLRA, does not include this alternative for separate analysis. The reduction of property alternative would, in effect, reduce the size of the military enclave; however, the impacts reasonably associated with the performance of FSH's mission in the future, as postulated by the two mission-related alternatives identified above, are the focus of this document.

2.2 ALTERNATIVE 1 – NO ACTION ALTERNATIVE (STATUS QUO)

Alternative 1, which this document assesses, would continue the military activities associated with FSH and the CLRA, with planned reductions in personnel and BASEOPS budgets. As discussed in Section 1, the existing mission of FSH is to command, operate, and administer FSH, the CLRA, and the sub-installation of Camp Bullis, to accomplish all assigned missions and to provide support to assigned, attached, and tenant activities. As noted previously, the activities that are conducted at Camp Bullis have been assessed in a separate EA (U.S. Army, 1999c). The following discussion describes the overall mission of FSH, which encompasses a wide range of activities that various organizations conduct at FSH. Figure 2-1 depicts the general layout of FSH, including the Department of Veterans Affairs Fort Sam Houston National Cemetery.

The U.S. Army Garrison, FSH (Garrison), provides the Headquarters function for the post and supports the overall, day-to-day operation of the majority of activities that are conducted at FSH and the CLRA. The Garrison provides support to assigned, attached, satellite or tenant units or activities, including on-post and off-post units/agencies in the assigned geographical area that are subordinate either to MEDCOM or one of the major FSH tenants, or are otherwise assigned to or associated with the FSH command structure. These activities include the promulgation of orders, issuing of regulations and policy, administration and management of the post, and personnel actions associated with the following specific Garrison tasks:

- Command and support assigned and attached MEDCOM and FORSCOM activities, units, and the sub-installation of Camp Bullis;
- Organize, train, and equip all assigned and attached units and individuals to perform assigned missions;
- Plan, coordinate, and prepare for the mobilization of Reserve Component units and individuals, and be prepared to rapidly expand installation functions and facilities to accommodate projected Reserve Component units upon arrival in the event of a mobilization action;
- Provide for the operation, safety, security, administration, education and training, contracting support, maintenance, supply, and transportation of all units, individuals, and activities assigned, attached, or under the command of the installation;
- Provide base operations support and other support to the Department of the Army, DoD, and other Government activities that are tenants of, supported by, or satellites of the installation;
- Plan, program, allocate, and supervise the use of resources and facilities for MEDCOM basic and support missions, functions, and responsibilities;
- Develop and conduct morale support programs (community and skill development activities, libraries, and physical activities);
- Provide for religious and moral needs of the command;
- Review and analyze programmed force structure changes as provided by higher headquarters, program construction to provide required facilities to accommodate programmed force changes, and program Operations and Maintenance Army (OMA) funding requirements and initiate requisition actions; and
- Preserve law and order within the FSH jurisdictional areas of responsibility.

Several major construction and demolition projects anticipated at FSH and the CLRA in the foreseeable future are detailed, and the associated impacts analyzed, in the FSH PEIS (U.S. Army, 2000a). Under normal conditions, new and replacement facilities will periodically be required and existing facilities will need to be demolished. Under these circumstances, the United States Army Garrison manages a NEPA environmental evaluation process for individual projects. The program is designed to ensure that future actions are individually evaluated, particularly in view of the significant cultural resource awareness at FSH.

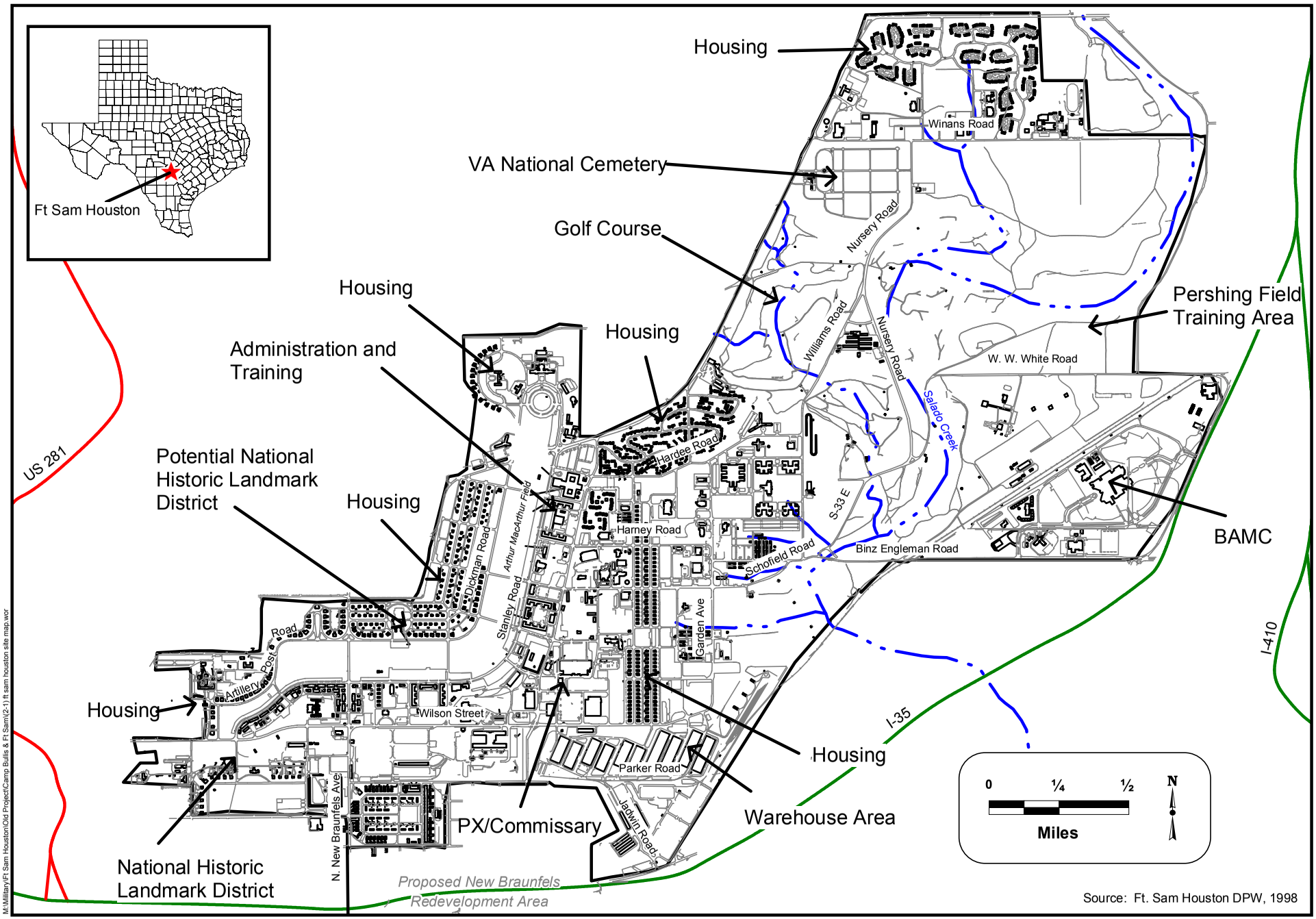


Figure 2-1 -- Fort Sam Houston Site Map

Operations and Maintenance (O&M) programs probably are more diverse than any other activity on the post. FSH requires operation and maintenance of a wide range of buildings (including barracks, industrial, storage, housing, medical, emergency response, dining, training, recreation, retail, warehouse), utilities (sewer, water, electricity, gas, communications), roads and streets, vehicles, fuel storage facilities, and any other permanent structure and/or equipment located at FSH. Of particular note, special considerations are required regarding O&M of historic buildings, of which FSH has more than 728. The CLRA requires O&M support for an unimproved road system, water and sewer systems with treatment facilities, bath and shower facilities, fuel storage facilities, a marina with boat service and storage, a helicopter landing pad, and other associated support buildings.

Light industrial activities at FSH, which fall within the purview of the Garrison, include warehouse and depot activities and equipment maintenance. Some maintenance activities are associated with the storage of various commodities in warehousing operations and with vehicle maintenance and storage.

The Community Activities Business Center maintains a wide range of facilities and organizes as many as 30 sports. Sport facilities include swimming pools, golf courses, gymnasiums, tennis courts, bowling lanes, handball/racquetball/squash courts, outdoor sports fields, horseback riding, and paintball. Non-athletic activities include picnicking, crafts, and hobbies.

Land use on FSH and the CLRA, discussed in detail below, is controlled by the Installation Commander through the application of a comprehensive Land Use Plan (U.S. Army, 2000a). The FSH Land Use Plan divides the available land into different land use categories, with attention given to historic properties and National Historic Landmark Districts (NHLD) (existing and potential). In addition, visual zones are imposed on the planning process as a key control measure to ensure that aesthetics are included in any decision affecting land use. The establishment of visual zones is often related to historic property concerns, and each of the seven identified visual zones contains criteria such as concern for similar architectural character, materials or scale, and a cohesiveness of function and form. The CLRA has also been assigned a single visual zone designation with applicable aesthetic criteria.

In the vicinity of FSH, the City of San Antonio is not proposing any major changes in land use. What were primarily agricultural areas on the eastern side of the installation are now becoming industrial/commercial developments. The San Antonio Development Agency has proposed a redevelopment of the area to the south of FSH along New Braunfels Avenue for the past 12 years.

The activities at the CLRA consist mainly of camping, fishing, boating, and swimming. Most of the development is along the ridge in the western half of the site. A post exchange and administration building with a parking area in the center of the site has areas designated for camping trailers, tent camping, and picnicking. Boating and swimming facilities have been constructed in the small cove in the northeast section of the area. The facility has its own wastewater treatment facility and a water well with an associated drinking water treatment and storage facility (see Figure 2-2).

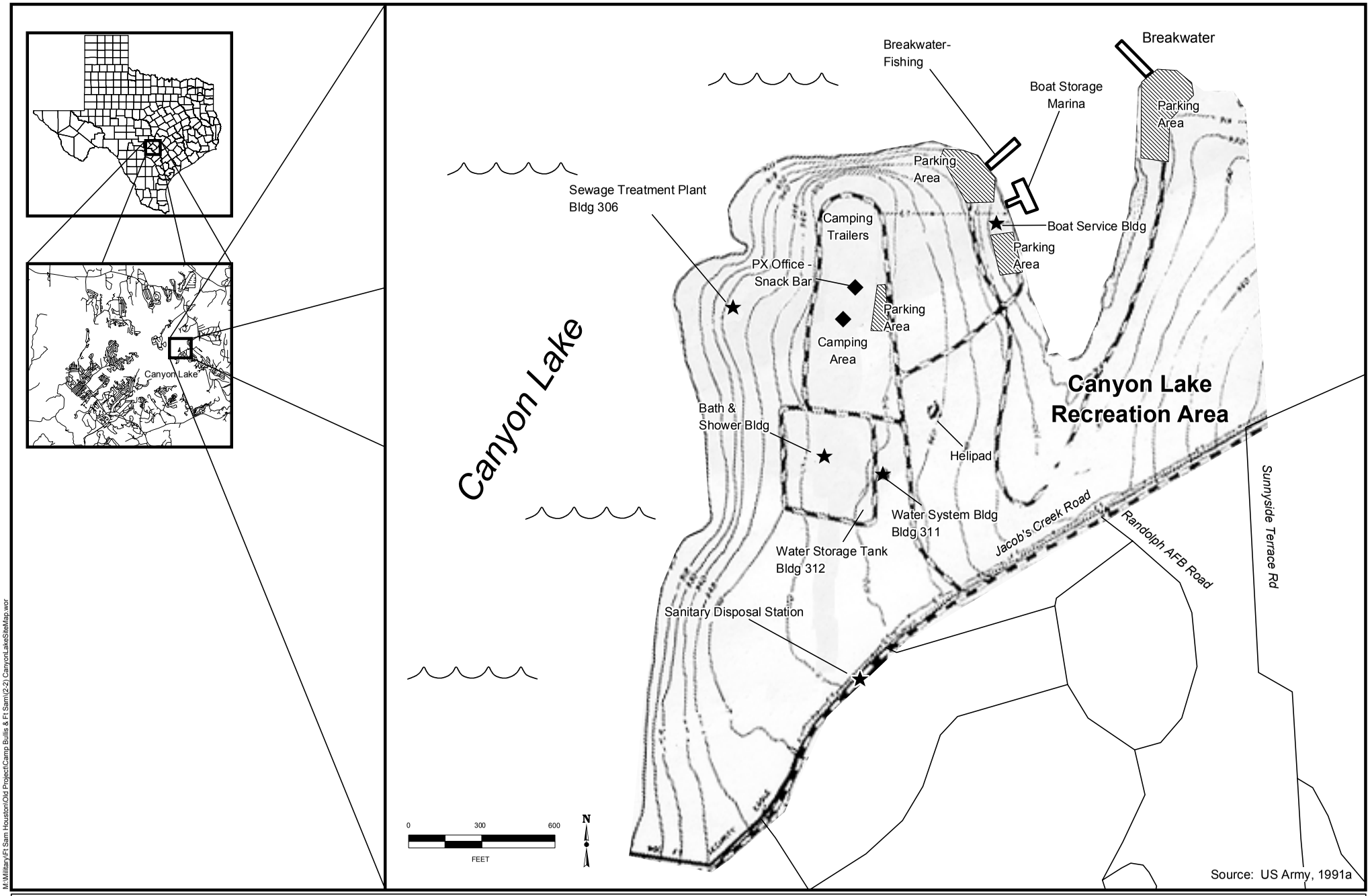


Figure 2-2 -- Canyon Lake Recreation Area Site Map

2.2.1 FSH Tenants

The first major tenant is the AMEDDC&S, which occupies the largest training facility at FSH. It provides training and education in health care services for the Army Medical Department; other DoD services; Federal agencies; and foreign allied military officers, enlisted personnel, and civilian medical personnel. Within the AMEDDC&S, the AHS represents the largest single allied military health training facility in the world. Training courses are offered to the entire range of medical personnel, including the Medical Corps, Dental Corps, Nurse Corps, Veterinary Corps, Medical Service Corps, Army Medical Specialist Corps, and all enlisted military medical occupational specialties. An average of approximately 3,965 resident students are accommodated at FSH. Table 2-1 shows the annual student load for FY 98.

Table 2-1 FY98 AMEDDC&S Student Load (Resident)

Medical Personnel	***AMEDDC&S Students***	***Defense Medical Readiness Training Institute (DMRTI) Students***	***Total Number***	***Percent of Total***
Officers	332	112	444	11%
Enlisted	2,007	0	2,007	51%
U.S. Army Reserve	1,514	0	1,514	38%
Total	**3,853**	**112**	**3,965**	**100%**

Source: U.S. Army, 2000a

The second major FSH tenant is the new BAMC, which occupies the new hospital facility in the northeast section of FSH. The hospital opened in the spring of 1996 and can provide all phases of medical and surgical care. The number of beds can be expanded from 450 to 651 if required to support wartime mobilization. In addition to patient care, BAMC provides a venue for graduate medical education programs, including the Institute for Surgical Research, 58 specialty clinics, and more than 600 ongoing research protocols each year in areas such as cardiology, dermatology, orthopedics, and emergency medicine. The San Antonio catchment area population is more than 187,000, with 1995 patient admissions of more than 19,500 and outpatient treatment visits of more than 680,000 (BAMC, 1996).

Medical research, development, testing, and evaluation are major functions of the various medical activities at FSH. Significant medical research and testing activities are conducted by the Institute for Surgical Research (not affiliated with BAMC, but part of the Medical Research and Development Command), the Area Dental Activity, the BAMC Preventive Medicine Service, and the Medical Test Agency.

The third of the five major FSH tenants is MEDCOM. The mission of MEDCOM is to provide health services for the Army, both active and reserve component forces,

including the training of health care personnel. To carry out this mission, MEDCOM provides the following services: medical research and development; technical and military training; veterinary services; dental care; and health promotion and wellness programs for U.S. Army units at home and abroad. Both BAMC and AMEDDC&S are subordinate to MEDCOM.

The fourth major tenant at FSH is the Headquarters, Fifth U.S. Army. This organization is responsible for training and readiness of Army and National Guard and Reserves in the western United States. In addition, it is responsible for coordination and execution of support to civil authorities.

The U.S. Army Fifth Recruiting Brigade (Southwest), the last of FSH's five identified major tenants, directs the Army military recruiting activities in the region and has overall responsibility for specialized recruiting programs, such as the Army Nurse Corps. In addition, it helps the Army Reserve, Army National Guard, and Army Medical Department recruit for other miscellaneous specialized personnel programs.

The FSH Independent School District (ISD) was established by the State of Texas. It includes an elementary school and a junior/senior high school on FSH for the children of military personnel living on the installation. The Department of Veteran Affairs (VA), which is not a tenant, operates the adjacent FSH National Cemetery as part of the Veterans Administration National Cemetery System.

It is anticipated that the 90th Regional Support Command (RSC), U.S. Army Reserve, will slightly increase its presence at FSH in the future. A new Reserve Center Equipment Concentration Site has been constructed on a 15-acre parcel in the warehouse area of FSH, and the current Reserve activities that use two facilities in San Antonio can now consolidate in the new facility. Plans for Reserve personnel include restationing of nine additional units of the 90th RSC by the end of 2001. The permanent Reserve component at the new center is expected to total 52, with approximately 800 Reservists using the facility over three weekends per month. The majority of the Reservists would come from the greater San Antonio area, and those who would commute from outside the region would be accommodated in barracks on FSH or Camp Bullis during their drill weekend (U.S. Army, 2000a).

2.2.2 PEACETIME STRENGTH

The most recent FSH and Camp Bullis authorized strength data (Table 2-2) are from the ASIP for 1999 through FY 2005 (U.S. Army, 1999a). The ASIP provides planning guidance data that change over the planning cycle, but usually only in small increments. The table shows that the base population under the No Action Alternative is expected to decrease 3.6 percent from 1999 to 2005.

Table 2-2 Fort Sam Houston Population Profile, FY 1999 – FY 2005

Element	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	% Change 1999-2005
Military Personnel								
Officers	2,835	2,688	2,739	2,742	2,741	2,741	2,741	-3.4%
Warrant Officers	94	72	73	73	73	73	73	-28.8%
Enlisted	8,232	8,027	8,470	8,336	8,303	8,303	8,303	0.9%
Total Military	**11,161**	**10,787**	**11,282**	**11,151**	**11,117**	**11,117**	**11,117**	**-0.4%**
Non-military Personnel								
DoD Civilians	5,052	4,615	4,457	4,455	4,456	4,454	4,454	-13.4%
Other Civilians	2,165	2,166	2,166	2,167	2,167	2,167	2,167	0.09%
Total Civilians	**7,217**	**6,781**	**6,623**	**6,622**	**6,623**	**6,621**	**6,621**	**-9.0%**
Total Population	**18,378**	**17,568**	**17,905**	**17,773**	**17,740**	**17,738**	**17,738**	**-3.6%**

Source: U.S. Army, 2000a

2.2.3 MOBILIZATION STRENGTH

Mobilization is the process of assembling and organizing national resources to support national objectives in time of war or other emergencies. Mobilization involves deploying active Reserve and National Guard units and individuals and converting installations to long-term mobilization mission training, medical, and support centers. There are five levels of mobilization, each designed to deal with increasing magnitudes of conflict:

- **Selective Mobilization** is the expansion of active forces by mobilization of Reserve units and/or individuals in response to a domestic emergency. Initiated by the President or Congress upon special action, this call-up does not involve contingency plans for deploying units overseas in response to an external threat to national security.
- **Presidential Selective Reserve Call-up** is the augmentation of active forces by up to 200,000 individuals of the Selected Reserve, for up to 270 days, to meet operational mission requirements. Crisis response involves both a presidential Selective Reserve call-up and deployment of portions of the active and Reserve armed forces.

- **Partial Mobilization** is the augmentation of active forces but falls short of full mobilization. The President can mobilize up to one million Ready Reservists for up to 24 months to meet requirements of war or other emergencies involving an external threat to national security. Congress can initiate partial mobilization levels up to full mobilization. The number of personnel and duration of mobilization initiated by the President may be extended by Congress.
- **Full Mobilization** activates Reserve and National Guard units, and individual Reservists in the existing approved force structure, to meet the requirements of war. Full mobilization requires a national emergency and passage of a public law or joint resolution by Congress declaring war.
- **Total Mobilization** expands the active armed forces by organizing and/or activating additional units beyond the existing force structure and other resources needed for their support. Total mobilization meets the requirements of a war or another national emergency or external threat to the national security. Analysis of the total mobilization scenario is beyond the scope to this EA because total Army strength under this condition is undetermined and would require congressional action.

FSH, in consideration of its real property master planning process, recognizes the need to factor in the potential impacts of mobilization on the installation's capabilities. This planning process includes a Mobilization Component (MC) that assesses the installation's billeting, utility, communications, transportation, training, and other support facilities. The MC describes the deficiencies identified in relation to design-population-expansion requirements to support full mobilization needs. The existing MC is based on installation mission requirements as contained in the Army Mobilization and Deployment Planning System, U.S. Army Training and Doctrine Command (TRADOC) Mobilization and Operations Planning System, the *Fort Sam Houston Mobilization Plan* and the *Army Mobilization Plan*, and on the installation peacetime and mobilization list of March 1998. Also, focused mobilization guidance is contained in the *Mobilization Master Plan, Fort Sam Houston and Camp Bullis,* dated September 1990 (U.S. Army, 2000a).

In support of mobilization activities, the combined FSH and Camp Bullis military population is projected to rise from an estimated 11,161 at peacetime to an estimated 46,400 by peak mobilization (Table 2-3). After peak mobilization, the military population would fall to a sustained population of 41,800 with a civilian and military population of 59,100 (U.S. Army, 2000a).

Table 2-3 Mobilization Population – FSH and Camp Bullis

Element	*Peak Mobilization Strength*	*Sustaining Base*
Military	46,400	41,800
Civilian	11,000	10,300
Patients	3,500	3,500
Dependents	3,500	3,500
Total Population	***64,400***	***59,100***

Source: USACE, 1990

2.3 ALTERNATIVE 2 – ADAPTIVE REUSE OF FACILITIES AND PROPERTY BY MILITARY AND FEDERAL USERS

Alternative 2, Adaptive Reuse of Facilities and Property by Military and Federal Users, differs from the No Action Alternative through the proposed adaptive reuse of currently vacant facilities (including some historical buildings), or an increase in available funding for maintenance of historical properties from traditional government sources. Adaptive reuse may be accomplished in one or, as in most cases, a combination of different methods:

- Additional military missions through individual stationing decisions that take advantage of the capabilities of FSH;
- Additional Federal missions, other than DoD, through individual stationing decisions that take advantage of the capabilities of FSH; or
- A combination of additional *military* and *Federal* missions.
- Provide developer(s) willing to participate in the development of available historic real estate assets through new leasing agreements.

Additional military missions through individual stationing decisions that take advantage of the capabilities of FSH may be a part of ongoing studies and analysis, such as the Tri-Service Interstate Training Review Organization (ITRO) or DoD Lease Reduction process, Active Component/Reserve Component/National Guard unit activations or restationings, and/or stationing decisions moving units to FSH through a formal BRAC-like process.

Other Federal agency missions that could take advantage of the capabilities of FSH through individual stationing decisions cannot be specifically identified at this time. However, the capacity of facilities (added personnel) beyond the current requirements at FSH can be estimated for the environmental impacts analysis of this EA.

The FSH PEIS lists current real estate actions at FSH and the CLRA and discusses buildings and underutilized/unutilized facilities that are being considered for management action that could cause adverse effects. This EA will not repeat the

specifics of that analysis because it pertains mainly to the real property impacts and the planning process. This EA focuses, rather, on the impacts associated with the potential increased base personnel strengths, as they relate to future FSH mission activities, that could be anticipated under Alternative 2.

2.3.1 Peacetime Strength

FSH officials estimate that an additional 2,416 personnel, 70 percent civilian and 30 percent military, could be included in the installation population through adaptive reuse of vacant facilities by Federal agencies. These personnel are anticipated to use three groups of facilities: (1) the 331,000 square feet (sf) in Beach Pavilion Complex, (2) the 227,000 sf in the former BAMC Main Hospital, and (3) other former BAMC facilities totaling 726,000 sf. For this EA, it is assumed the space could be filled by new tenants beginning in FY 2000 in annual increments through FY 2005 (U.S. Army, 2000a).

Peacetime strength authorized for DoD and other Federal agencies at FSH and Camp Bullis could increase as shown in Table 2-4. These potential increases are estimates based on full utilization of currently available space, regardless of its present condition, assuming that appropriate funding is secured.

Table 2-4 Potential Peacetime Authorized Strength Under Maximum Reuse by Federal Users, Fiscal Year 1999 through Fiscal Year 2005

	FY 1999	***FY 2000***	***FY 2001***	***FY 2002***	***FY 2003***	***FY 2004***	***FY 2005***
Military	11,161	10,970	11,948	11,700	11,849	12,932	12,032
Civilian	7,217	7,206	7,480	7,907	8,336	8,762	8,762
Total Population	***18,378***	***18,176***	***19,428***	***19,607***	***20,185***	***21,694***	***20,794***

Source U.S. Army, 1999a (ASIP)

2.3.2 Mobilization Strength

Mobilization strength authorized at FSH (and Camp Bullis) would remain the same as shown in Table 2-3 for Alternative 1.

2.3.3 Mission Activities Fort Sam Houston and Canyon Lake Recreational Area

Mission activities under Alternative 2 include the activities described in Alternative 1. In addition, Alternative 2 includes the new military and Federal missions that could be relocated to FSH to take advantage of the installation's excess capabilities.

For example, a mission that could be accommodated at FSH is the Naval Recruiting Center, which is being considered to occupy the Beach Pavilion Complex. Potential reuse actions include several organizations moving from Kelly Air Force Base as a result

of the BRAC action there. Currently, Building 2376, part of the Beach Pavilion Complex, is being rehabilitated according to the *Secretary of the Interior's Standards for Rehabilitation* by the Military Entrance Processing Station (MEPS) for that military mission. An example of a successful transfer of FSH property to a Federal agency is the excessing of Building 4019 to the General Services Agency (GSA) with protective covenants. It will be rehabilitated and leased at fair market value (U.S. Army, 2000a).

Actions to renovate and relocate Federal agencies within FSH and transfer lands to other Federal agencies could result in land use category changes on the installation. These potential changes are addressed in detail in the FSH PEIS. No land use changes are anticipated for the CLRA.

2.3.4 Facility Management

Under Alternative 2, construction, facility removal, and real estate activities would generally remain the same as those described under Alternative 1. However, as a result of the potential mission activities discussed above, some of the buildings currently scheduled for removal under Alternative 1 may be renovated and reused under Alternative 2. The FSH PEIS provides more detailed information concerning the current status of military organizations leasing space in the San Antonio area that could use space on FSH.

2.4 ALTERNATIVES CONSIDERED BUT NOT CARRIED FORWARD FOR FULL ANALYSIS

The alternative of minimum use of facilities and property, or release of all property on the installation to other governmental or private agencies, was considered, but not carried forward. This alternative would require relocation of all missions currently assigned to FSH.

The Army underwent the BRAC Installation Assessment Program in 1995. This program quantitatively assessed all installations. It characterized installations, developed measurable characteristics, collected certified data, and calculated relative installation merit by installation category. FSH is a valuable MEDCOM installation, providing unique medical training and care in support of overall national strategy.

The minimum use alternative amounts to, in effect, a BRAC action that could not meet the significant, recognized need for a continuation of the current missions at FSH. Because future BRAC actions will require separate analysis and environmental impact documentation under NEPA, this alternative was not carried forward.

3.0 AFFECTED ENVIRONMENT

3.1 FORT SAM HOUSTON MILITARY RESERVATION

3.1.1 Earth Resources – FSH

Earth resources discussed in this section include geology, soils, and topographic features associated with FSH. The region of influence or interest (ROI) for earth resources is the area within the physical boundaries of FSH.

3.1.1.1 Geology

The bedrock that underlies FSH has been mapped by Barnes (1974) as the Navarro Group and Marlbrook Marl overlain with Quaternary (recent) stream deposits. This formation is composed of marl, clay, sandstone, and siltstone, with concentrations of siderite and siliceous limestone. The stream deposits along Salado Creek form terraces consisting largely of gravel, sand, and silt up to 45 feet thick. These stream terraces were formed during the Pleistocene age with recent alluvium forming the deposits in the present Salado Creek floodplain (U.S. Army, 1991a). Figure 3-1 depicts the geology of FSH.

The major structural feature in the San Antonio region is the band of faulting associated with the Balcones Fault Zone, which separates the Edwards Plateau from the coastal Plain area. This fault scarp has been eroded by numerous small streams and has left a number of alluvial terrace deposits at the base of the escarpment. The Balcones Fault Zone is approximately 15 to 20 miles wide and runs southwest to northeast through the San Antonio region.

3.1.1.2 Soils

The soil resources of FSH have been studied in detail by the Natural Resources Conservation Service (USDA, 2000). The majority of FSH is composed of soils that are susceptible to severe or moderate erosion. The erosive potential and stability of a soil depend on its structure, texture, organic matter content, moisture content, permeability, and degree of slope. The soils at FSH are characteristically fertile and are generally maintained with grasses and trees to prevent erosion. Despite these erosion control efforts, several problem areas have been identified. An extensive erosion survey and controls design has been conducted through the U.S. Army Corps of Engineers (USACE, 1996). The soil series found at FSH are shown in Figure 3-2, and their relative percentages are shown in Table 3-1.

The western, upland portion of the installation consists primarily of the Houston Black Soil Series. These soils consist of clayey particles that are dark gray to black and calcareous. Houston Black soils have slow to high surface drainage and poor to nonexistent internal drainage and are nearly level to strongly sloping. Runoff from the Houston Black soils can be fairly rapid when they exhibit slopes greater than 1 percent, and erosion problems can be severe.

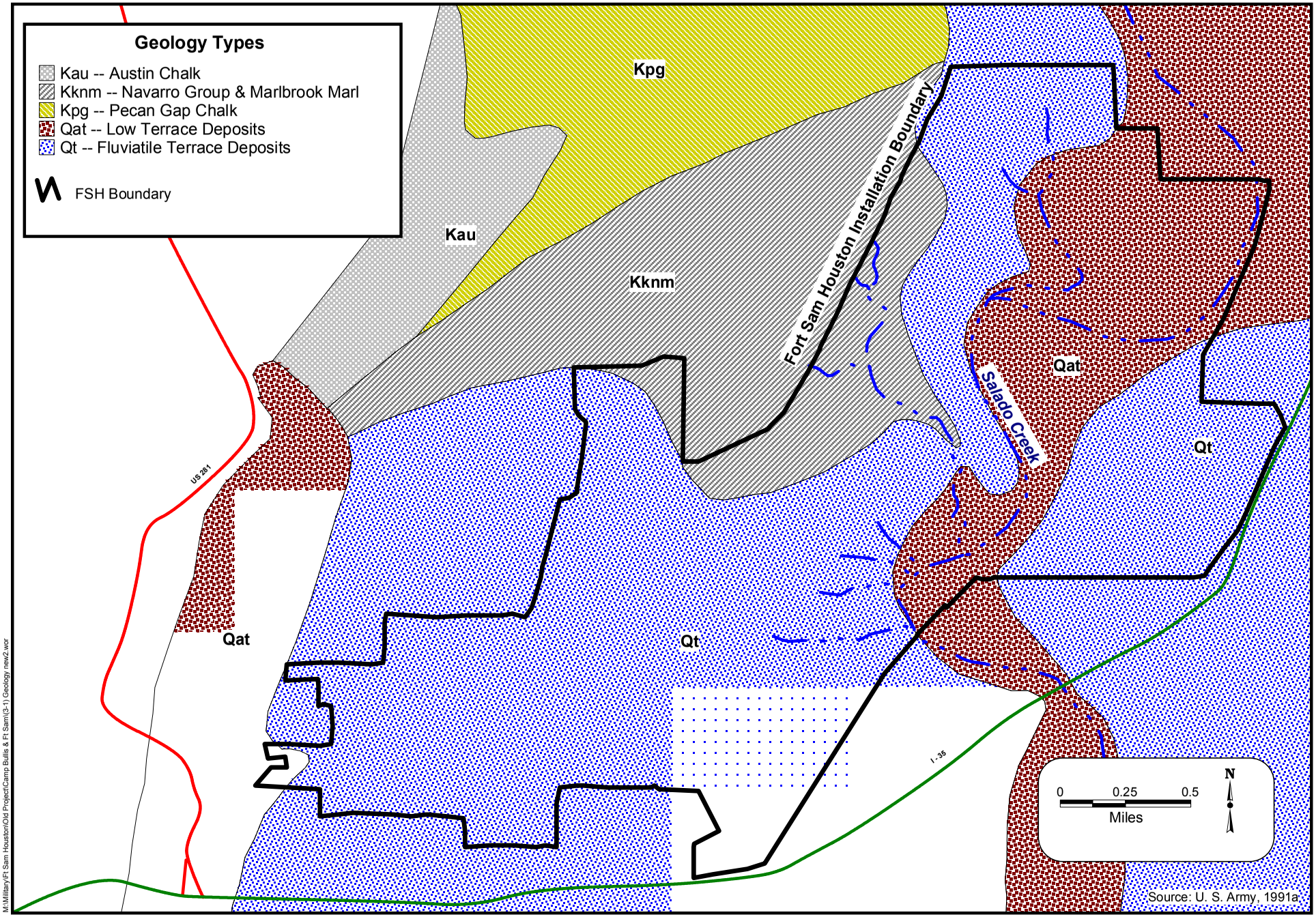


Figure 3-1 -- Fort Sam Houston Geology Map

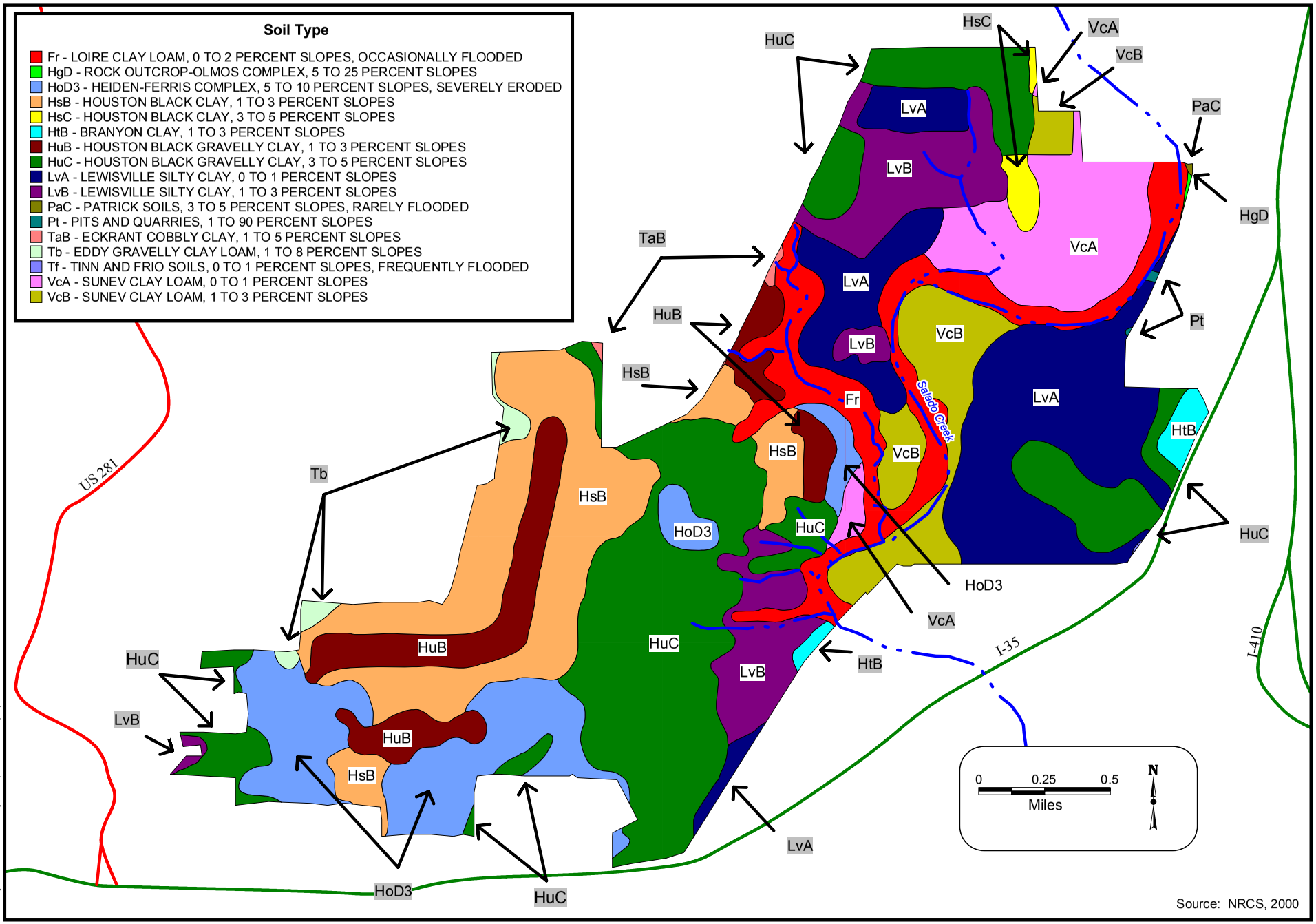


Figure 3-2 -- Fort Sam Houston Soils Map

Table 3-1 Extent of Soils at FSH

Soil Series	Acreage	Percentage of Area
Houston Black	1,657	52.6
Lewisville	728	23.1
Tarrant	33	1.0
Frio	182	5.8
Trinity & Frio	137	4.4
Venus	413	13.2
TOTAL	**3,150**	**100**

Source: U.S. Army, 1988.

These soils are fairly productive, and in rural areas they are cultivated for grains and fiber crops (cotton). Soils of the Lewisville series, found in the northwestern and south-central region of FSH, are moderately deep soils consisting of silty clay formed over the higher terrace deposits. They are some of the more productive soils in Bexar County and can be easily tilled and worked. If left unprotected, however, the Lewisville soils are susceptible to severe erosion. Tarrant soils, which comprise an undulating chalk substratum, occur in patches in the western portion of the installation. The soils in the eastern portion of the installation are derived from various stream terrace deposits. The Trinity and Frio soils occupy the bottomlands and low terraces along Salado Creek. These soils, which form over recent alluvium, frequently flood. Venus soils, consisting of clay loams over older alluvium, are not subject to stream overflows (U.S. Army, 1991a).

3.1.1.3 Area Physiography/Topographic Features

The regional physiography is governed primarily by the Balcones Escarpment, a broad area of faulted limestone forming the southern and eastern edge of the Edwards Plateau. This escarpment rises approximately 1,000 feet above the coastal prairie to the south and east. The escarpment extends from near Del Rio, Texas, about 160 miles to the west, through Bexar County, to Austin, Texas, about 70 miles to the northeast. Remnants of the escarpment extend as far north as Waco, Texas. This physical feature runs northeast to southwest through the San Antonio area (U.S. Army, 1991a).

To the northwest of the escarpment lies the Edwards Plateau, a rugged hilly region dissected by many small streams. Elevations in the Plateau range from 1,100 to 1,900 feet above mean sea level (msl). The Edwards Plateau was mapped by Fenneman (1931) as part of the Great Plains Province. Along the base of the escarpment is a hilly area classified as the Blackland Prairie Physiographic Region, which is where FSH is located (Taylor et al., 1966). Much of this region is covered with gravelly terrace deposits with some valleys cut by stream erosion (U.S. Army, 1991a).

3.1.2 Air Quality – FSH

The Clean Air Act, Title 40 CFR Parts 50 and 51, dictates that the National Ambient Air Quality Standards (NAAQS), established by the Environmental Protection Agency (EPA), must be maintained nationwide. The NAAQS have been set forth to protect the public health and welfare with an adequate margin of safety. FSH currently is listed in an attainment area for all of the NAAQS. The NAAQS include standards for six "criteria" pollutants: ozone (O_3), nitrogen dioxide (NO_2), carbon monoxide (CO), "respirable" particulates (particulate matter less than 10 microns in diameter [PM_{10}]), sulfur dioxide (SO_2), and lead (Pb). These standards include short-term standards (1-hour, 8-hour, or 24-hour periods) for pollutants with acute health effects, and long-term standards (annual average) for pollutants with chronic health effects.

Air quality at a given location is a function of several factors, including the quantity and dispersion rates of pollutants in the region, temperature, the presence or absence of inversions, and topographic and geographic features of the region. Climate plays an important role with respect to air quality, and therefore regional climate is discussed in the Climate subsection (Section 3.1.2.1). For the purposes of this EA, the ROI for air quality is the area immediately surrounding FSH (including the City of San Antonio, Comal County, Kendall County, Bandera County, Medina County, Atascosa County, Wilson County, and Guadalupe County).

3.1.2.1 Climate

FSH and the CLRA are located on the edge of the Gulf Coastal Plains, which results in a modified subtropical climate, predominantly continental during the winter months and marine during the summer months. Normal mean temperatures range from 50.7°F in January to 84.7°F in July. The summer is hot, with daily temperatures above 90°F more than 80 percent of the time. Extremely high temperatures are rare; the highest on record is 108°F in August 1986. Mild weather prevails during much of the winter months, with below-freezing temperatures occurring, on average, about 20 days each year. The record low temperature was -6°F in January 1990 (U.S. Army, 1991a).

The San Antonio area is situated between a semi-arid area to the west and the coastal area of heavy precipitation to the southeast. The average rainfall of 27.54 inches is sufficient for normal production of most crops; however, rainfall is highly variable from year to year in this region. Rainfall averages approximately 28 inches annually, but may range from less than 20 inches to 40 inches, with some years having none at all (Eckhardt, 1995a). Precipitation is fairly well distributed throughout the year; the heaviest amounts fall during May and September. From April through September, precipitation usually consists of thunderstorms, with fairly large amounts falling in short periods of time. Most of the winter precipitation is light rain or drizzle. Because of its proximity to the Gulf, tropical storms bring high winds and prolonged rainfall. Thunderstorms and heavy rainfalls have occurred in all months of the year. Hail of damaging intensity is rare, but light hail frequently accompanies the springtime thunderstorms. Measurable snow falls only once every 3 or 4 years; the greatest single snowfall recorded was 13.2 inches on 12 January 1985 (U.S. Army, 1991a).

Northerly winds prevail during most of the winter, while southeasterly winds from the Gulf of Mexico prevail during the summertime and near the ground surface for long

periods during the winter. However, winds at the upper levels (1,000 meters) are primarily from the south. Rather strong northerly winds occasionally occur during the winter months in connection with "northers". No tornadoes of any consequence have been recorded in the immediate area since 17 April 1988, when an estimated 10 to 12 tornadoes associated with Hurricane Gilbert (a Class 5 hurricane) struck the area (U.S. Army, 1991a).

3.1.2.2 Current Attainment Status

FSH is located in EPA Region VI. The EPA has divided the country into geographic regions known as air quality control regions (AQCRs) in order to evaluate compliance with the NAAQS. The state air pollution control authority for FSH is the Texas Natural Resource Conservation Commission (TNRCC) located in Austin, Texas. The State of Texas has adopted the Federal Clean Air Act NAAQS as the State's Air Quality criteria. Primary standards are established to protect human health while secondary standards protect structures and vegetation. The NAAQS are summarized in Table 3-2.

Table 3-2 Federal National Ambient Air Quality Standards

Federal NAAQS			
Air Pollutant	**Averaging Time**	**Primary (>)**	**Secondary (>)**
Carbon monoxide	8-hour average	9 ppm	--
	1-hour average	35 ppm	--
Nitrogen oxides	Annual arithmetic mean	0.053 ppm	0.053 ppm
Sulfur dioxide	Annual arithmetic mean	0.03 ppm	---
	24-hour average	0.14 ppm	---
	3-hour average	---	0.5 ppm
PM_{10}	Annual arithmetic mean	50 $\mu g/m^3$	50 $\mu g/m^3$
	24-hour average	150 $\mu g/m^3$	150 $\mu g/m^3$
$PM_{2.5}$	Annual arithmetic mean	15 $\mu g/m^3$	15 $\mu g/m^3$
	24-hour average	65 $\mu g/m^3$	65 $\mu g/m^3$
Ozone	8-hour average	0.08 ppm	0.08 ppm
Lead	Calendar quarter	1.5 $\mu g/m^3$	1.5 $\mu g/m^3$

ppm – parts per million; $\mu g/m^3$ = micrograms/cubic meter
Source: 40 CFR Part 50, 1994 and EPA news release February 27, 2001.

FSH is located in the Metropolitan San Antonio Intrastate AQCR (number 217) in Bexar County, Texas. This area is currently listed as in attainment for all six of the criteria pollutants – O_3, CO, PM_{10}, NO_X (listed as NO_2 elsewhere), Pb, and SO_2. Three continuous air monitoring stations (CAMS) in San Antonio monitor NO_x and O_3. One of these stations is located at Camp Bullis. In addition, there is a PM_{10} particulate matter sampler and a $PM_{2.5}$ particulate matter sampler, each at a different location (TNRCC website, 2001).

In February 2001, the U.S. Supreme Court upheld the EPA's decision to incorporate new health-protective ambient air standards for ground-level ozone and particulate matter. These two standards, originally published in 1997, were temporarily withdrawn, but now will be implemented nationwide. The impact of these new standards on the attainment designations for the region of Texas that FSH is located in is not clear. It is very possible, however, that the San Antonio region may become classified as nonattainment for ozone under the new standard. If this occurs, the EPA and the State would have to confer and establish reduction goals within a set time frame to attain compliance with the new levels. Under these circumstances, FSH would be required to comply with these strict requirements. Steps that have been taken to reduce pollutant levels include installing Stage II vapor recovery systems at large fueling points, and it may be necessary to impose additional or more stringent control standards on VOC-emitting facilities.

Bexar County is identified as a "covered attainment" area for VOCs. Covered attainment is a special designation in Texas that applies to areas where specific sources have restrictions. In this case, the restrictions apply to loading racks, an operation that does not apply to Fort Sam Houston.

The CAA provides different pollutant concentration maximums depending on what type of geographical area is involved and what type of activity is ongoing. Section 169A states that it is a national goal to prevent any further impairment of visibility within federally mandated Prevention of Significant Deterioration (PSD) Class I areas from man-made sources of air pollution. The air quality impacts in combination with other PSD sources in the area must not exceed the maximum allowable incremental increases identified in Table 3-3. Certain national parks and wilderness areas are designated as Class I areas, where any appreciable deterioration in air quality is considered significant. Class II areas are those where moderate, well-controlled industrial growth is permitted. Class III areas allow for greater industrial development. Fort Sam Houston is located in a Class II area.

Air emissions at FSH are associated with several large boilers, mobile sources, fuel storage facilities, and miscellaneous solvent and paint use. An Air Pollution Emission Statement was prepared for FSH during 18-28 January 1994 by the U.S. Army Environmental Hygiene Agency (USAEHA) with the purpose of identifying and quantifying emissions of volatile organic compounds (VOCs), nitrogen oxides (NOx), and other air pollutants from stationary air pollution sources at FSH (this study included Camp Bullis and the CLRA). Emissions from FSH were less than the regulatory thresholds and therefore no information regarding air pollution sources was filed with TNRCC at that time (USAEHA, 1994). Subsequently, the criteria pollutant emissions were updated, and Table 3-4 summarizes the FSH Annual Criteria Pollutant Emissions for 1997 (Pacific Western, 1998).

Table 3-3 Maximum Allowable Pollutant Concentrations

		Maximum Allowable Increment (µg/m^3)		
Pollutant	**Averaging Period**	**Class I**	**Class II**	**Class III**
NO_x	Annual	2.5	25	50
SO_2	Annual	2	20	40
	24-hr	5	91	182
	3-hr	25	512	700
PM_{10}	Annual	4	17	34
	24-hr	8	30	60

Source: 40 CFR Parts 51 and 52, as revised 1 July 1994

Note: Class I areas are regions in which air quality is intended to be kept pristine, such as national parks and wilderness areas. All other areas are initially designated Class II. Individual states have the authority to re-designate Class II lands as Class III to allow maximum industrial use, although none has been re-designated to date.

More than 4,000 boilers and hot water heaters are in operation at FSH. Among the largest are the BAMC, Academy of Health Science, Fifth Army Headquarters, troop dining facilities, and the Beach Pavilion building (previously a medical building associated with the old BAMC complex). All heating units are fueled by natural gas. The previously referenced Air Pollution Emission Statement addressed 31 commercial natural gas-fired boilers and three industrial natural gas-fired boilers. All other boilers were assumed to have a capacity less than 0.3 million British Thermal Units per hour (MBtu/hr) and were therefore classified as residential.

Table 3-4 Summary of the FSH Annual Criteria Pollutant Emissions as Identified in the Air Pollution Emissions Statement

Sources	**Tons/year**				
	PM10	*SO_2*	*CO*	*NOx*	*VOCs*
Boilers/Furnaces	1.10	0.05	2.80	11.17	0.23
Generators	0.42	1.0	1.28	5.94	0.48
Fuel Storage/Dispensing	---	---	---	---	3.72
Degreasing	---	---	---	---	8.70
Surface Coating	---	---	---	---	1.44
Pesticides	---	---	---	---	3.17
Sterilizers	---	---	---	---	0.26
Landfills	---	---	---	---	6.27
Woodworking	1.71	---	---	---	---
Firefighter Training	<0.01	---	0.02	---	<0.01
Miscellaneous VOCs	---	---	---	---	10.80
Totals	*3.23*	*1.05*	*5.15*	*16.81*	*35.07*

Source: Pacific Western, 1998

Open burning is conducted at FSH only for semi-annual firefighter training and occasional bonfires for festival-type activities. Fuel for the firefighter training is approximately 1 bale of hay per event (USAEHA, 1994). Degreasing operations and landfill emissions are the two greatest sources of VOC emissions at FSH. An additional source includes fuel storage and dispensing activities associated with the post-operated stations. The two existing gas stations owned and operated by AAFES, and a new gas station associated with a new AAFES complex that will be constructed in the future, are not recognized by TNRCC to fall under FSH's emission umbrella. Thus, VOC and HAP emissions from these AAFES sources are not included in any emission assessment for FSH (Walker, 2001).

In October 1998, Pacific Western Technologies, Ltd. prepared an inventory of air emissions at Fort Sam Houston, including Camp Bullis and The Canyon Lake Recreation Center. Based on this inventory, CO emissions at Camp Bullis, at 112 tons per year, exceeded the Title V threshold of 100 tons per year. However, the State of Texas gave FSH relief for prescribed burning because it is a fugitive emission and therefore falls outside of Title V regulations. For this reason, FSH's air emissions are well below any of the Title V thresholds and therefore the installation is not required to obtain a Title V permit.

Three incinerators previously operational at FSH have been taken out of service, leaving no operating incinerators on post. According to the 1994 Air Pollution Emission Statement, four locations at FSH contain woodworking equipment, including the Department of Public Works Carpenter Shop, the Medical Arts Fabrication Section Shop, the Training Support Center (Building 4192), and the DOL woodshop (Bldg 4055). Dust and particulate collection equipment has been installed at all locations.

Title I of the Federal Clean Air Act Amendments of 1990 (CAAA-90) requires air pollution source owners in ozone nonattainment areas to submit an Emission Statement to local regulatory authorities. FSH is not currently located in an ozone nonattainment area and is therefore not subject to a mandatory submittal under this rule. Implementation of the new ozone NAAQS may mandate the submittal of annual Emission Statements in the future, but the regional attainment designation has not yet been evaluated for compliance with the new NAAQS for ozone.

Title V of the CAAA-90 requires each state to institute a permit program that assesses fees based on annual air pollutant emissions. The emission summaries provided by the emission statement may be used to calculate any applicable fees that are based on actual pollutant emission rates. The TNRCC requires all facilities with emissions greater than the regulatory threshold limits to file emission inventory information. Following the emissions surveys (USAEHA, 1994; Pacific Western, 1998), emissions from FSH were determined to be less than the regulatory thresholds, and therefore information regarding air pollution sources at FSH was not reported to TNRCC. FSH has no air quality noncompliance problems, and there are no current violations of air quality standards (USAEHA, 1994; Cibildak, 1996, Walker, 2001).

The ozone level requirements in the San Antonio area were exceeded twice during the summer of 1996, the first excess levels since 1988. For the year 2001, an ozone monitor located at Camp Bullis has recorded the following four highest 8-hour ozone averages: on May 23, 0.081 ppm; on June 18, 0.09 ppm; on June 11, 0.079 ppm; on

April 29, 0.075 ppm. The average of these four concentrations is 0.081 ppm. The 8-hour primary and secondary ozone ambient air quality standards are met at an ambient air quality monitoring site when the average of the annual fourth-highest daily maximum 8-hour average ozone concentration is less than or equal to 0.08 ppm. Thus, while the current four highest ozone concentrations for this area for CY 2001 exceed the new NAAQS, the new NAAQS standards have not yet been implemented.

3.1.3 Noise – FSH

The ROI for noise consists of the post itself, areas under the flight path of helicopters associated with BAMC, and areas of the City of San Antonio immediately adjacent to the post.

Noise is considered unwanted sound that interferes with normal activities or otherwise diminishes the quality of the environment. It may be intermittent or continuous, steady or impulsive, stationary or transient. Stationary sources are normally related to specific land uses (e.g., housing tracts, industrial plants, and mining operations). Transient noise sources move through the environment, either along established paths (e.g., highways, railroads, aircraft Military Training Routes [MTRs]) or randomly (e.g., an aircraft flying in a block of airspace). The wide diversity in responses to noise vary not only according to the type of noise and the characteristics of the sound source, but also according to the sensitivity and expectations of the receptor, the time of day, and the distance between the noise source (e.g., an aircraft) and the receptor (e.g., a person or animal).

Sound measuring instruments record instantaneous sound levels in decibels (dB). Sound levels for individual noise events and average sound levels, in dB, over extended periods of hours, days, months, or years can be calculated as the Daily Day-Night Average Sound Level (Ldn). Sound measurement is further refined through the use of "A-weighting". The normal human ear can detect sounds that range in frequency from about 20 Hertz (Hz) to 15,000 Hz. However, not all sounds in this range are heard equally well. Some sound meters, therefore, are calibrated to emphasize frequencies in the 1,000 to 4,000 Hz range, those to which the ear is the most sensitive. "A-weighted" sounds are those measured by such instruments.

Land use guidelines established by the Federal Interagency Committee on Noise (FICON) determined acceptable levels of noise exposure for various types of land use. Table 3-5 summarizes the major land uses and their compatibility with various levels of noise exposure expressed in Ldn. Some land uses are compatible with high noise levels and some activities associated with these uses do not require mitigative measures to attenuate overall noise exposure.

Methods used to quantify the effects of noise such as annoyance, speech interference, sleep disturbance, earth effects, and hearing loss have undergone extensive scientific development during the past several decades. The most reliable measures are noise-induced hearing loss and annoyance. Extra-auditory effects (those not directly related to hearing capability) are also important. The current consensus is that "evidence from available research reports is suggestive, but it does not provide definitive answers to the question of health effects, other than to the auditory system, of long-term exposure to noise" (NAS, 1981).

Table 3-5 Recommended Land Use for L_{dn} – Based Noise Zones

Land Use	Zone I (L_{dn} <65 dBA)[1]	Zone II (L_{dn} 65-75 dBA)	Zone III (L_{dn} >75 dBA)
Residential (all Uses)	Acceptable	Generally Unacceptable[2]	Unacceptable
Manufacturing	Acceptable	Acceptable	Acceptable[3]
Transportation, communication, and utilities	Acceptable	Acceptable	Acceptable
Trade	Acceptable	Acceptable	Acceptable[3]
Public Services	Acceptable	Generally Unacceptable[2]	Unacceptable
Cultural, recreational, and entertainment	Acceptable	Generally Unacceptable[2]	Unacceptable
Agricultural	Acceptable	Acceptable	Acceptable
Livestock farming and animal breeding	Acceptable	Acceptable	Unacceptable

Source: FICON, 1992

Notes: 1. L_{dn} is the dBA level averaged over a 24-hour period.

2. Use is generally discouraged; however, if allowed, sound attenuation techniques should be required.

3. For a L_{dn} level above 75 dBA, sound attenuation techniques should be required.

3.1.3.1 Current Noise Environment

The major sources of noise at FSH are automobiles and aircraft operations, notably periodic helicopter flights in and out of BAMC. These flights are generally routed over transportation corridors and nonsensitive areas. Flights over residential areas are avoided where practical. Automobile traffic is the largest generator of noise, particularly during rush hours.

3.1.4 Water Resources – FSH

This section briefly summarizes water resources in the vicinity of FSH. The surface water ROI includes FSH, Salado Creek, San Antonio River (via Alamo Ditch), and the San Antonio storm drainage system. The groundwater ROI relates to the deep Edwards Aquifer. FSH has partnered with the San Antonio Water System to use recycled water for cooling towers and irrigation on the installation. FSH's use of recycled water helps reduce dependency on the Edwards Aquifer and provides additional water for growth in the San Antonio area.

3.1.4.1 Surface Water

FSH is drained primarily by Salado Creek, which flows from north to south through the eastern portion of the reservation. The headwaters of Salado Creek are located in the northwestern part of the Camp Bullis Military Reservation area and Camp Stanley. The stream is intermittent and derives principally from precipitation in the area. Baseflow for Salado Creek entering FSH is primarily from runoff. A small tributary of the San Antonio River known as Alamo Ditch drains the western part of FSH. The southern and central portions of the installation are drained by San Antonio's storm drainage system (U.S. Army, 1991a).

The watershed within FSH is partially developed. Runoff from impervious surfaces such as pavement accumulates dust, debris, and soil from atmospheric fallout and automobile traffic. Runoff from this watershed is carried into the Salado Creek drainage system. Water quality has been examined at two gauging stations on the Salado Creek watershed, and results were within the TNRCC Standards for all parameters measured (chloride, sulfate, total dissolved solids, dissolved oxygen, pH, fecal coliform, and temperature). Salado Creek is recharged by springs near Interstate 410, which are located in the artesian zone of the Edwards Aquifer (USACE, 1996).

A *Storm Water Pollution Prevention Plan* (SWPPP) was prepared in June 1999 in accordance with the Final National Pollutant Discharge Elimination System (NPDES) *General Permit for Storm Water Discharge Associated with Industrial Activities* promulgated by EPA in September 1992. A total of 10 activities at FSH have been identified as "industrial activities" subject to the requirements of the Storm Water Multi-sector General Permit (MSGP). Those activities include seven maintenance facilities, one fueling facility, one hazardous waste storage site, and 11 closed landfills (considered one industrial activity for the SWPPP) (USACHPPM, 1999b). Several outfalls at FSH discharge into the municipal storm sewer system of the City of San Antonio. FSH is required by regulation to make its pollution prevention plan available to the municipal operator of the system upon request. At this time, no specific requirements are put forth in the City of San Antonio SWPPP concerning FSH (U.S. Army, 2000a).

To establish a baseline for water quality parameters, USAEHA assisted FSH in developing a Water Quality Biological Study. This study focused on water quality, vegetation, aquatic macroinvertebrates, fish, birds, and mammals associated with Salado Creek and its drainage basin on FSH. This study found mercury levels above freshwater aquatic life criteria. Individuals who consume fish from Salado Creek may be exposed to this contaminant. The study also concluded that the unimproved drainage basin of Salado Creek on FSH provides habitat for a variety of vegetation and wildlife (USAEHA, 1985).

The study recommended that additional detailed water sampling and analysis should be conducted on Salado Creek to determine the source of the mercury contamination, and chemical analysis of the fish tissues should be conducted to determine whether the mercury is depositing in tissues consumed by recreational fishermen. In addition, the study recommended that the watershed and habitat associated with Salado Creek should be protected from future development on FSH (USAEHA, 1985).

A 1995 FSH Solid Waste Landfill report identified eight former landfill sites located along Salado Creek, with six located within the Salado Creek floodplain. Landfills along Salado Creek have not received refuse since the mid-1970s. Sampling of Salado Creek found no correlation between the landfill locations and contaminant concentrations in Salado Creek (U.S. Army, 2000a). Elevated levels of chemical oxygen demand show a mixed relationship between landfill locations and water quality. Other sources of pollution exist on FSH, including runoff from irrigation on the golf course and other landscaped areas, as well as non-point sources originating on FSH that could impact water quality in Salado Creek. The SWPPP for FSH will be updated annually or more frequently, as determined by annual site compliance evaluations.

FSH has implemented a program in which surface water samples are collected quarterly at designated locations along Salado Creek (Rivera, 1997). Samples are taken upstream from FSH near landfill 12 and downstream near landfill 7 where Salado Creek exits FSH. Results for the first two quarters (June and November) of 1996 were reviewed. VOCs, semi-volatile organic compounds (SVOCs), and explosives were below the detection limit (BDL). Samples were also analyzed for metals (arsenic, barium, cadmium, lead, mercury, selenium, and silver); all of these metals are well below the maximum contaminant level (MCL).

3.1.4.2 Floodplains, Waterways, and Wetlands

Floodplains, as defined in Executive Order (EO) 11988 on Floodplain Management, are "lowlands and relatively flat areas adjoining inland or coastal waters including flood-prone areas of offshore islands, including at a minimum, that area subject to a 1 percent or greater chance of flooding in any given year" (i.e., that area that would be inundated by a 100-year flood). Floodplains are often classified as 10-, 25-, 50-, or 100-year floodplains, according to the average interval between major floods (USACE, 1996).

FSH has major flooding, on average once every 3 to 4 years, that inundates a large portion of the training area in the eastern sections of FSH and along Salado Creek. The western, southern, and central portions of FSH drain well, and no flooding problems have been reported in these areas (USACE, 1996) (see Figure 3-3).

In 1987, a study was performed to determine Salado Creek flood levels in the area of the proposed BAMC site and its access road. An existing conditions computer backwater model was created using cross section data from studies done in 1969 and 1987. Discharges were established for the 100-year and 500-year flood under both projected 1990 and 2020 conditions. The results showed that the channel and undeveloped floodplain of the over-banks are adequate to safely pass the 100-year flood with one notable exception. The area between Binz-Engleman Road and W.W. White Road would be subject to inundation from a flood as small as a 2-year frequency flood. During such an event, each crossing would be under 8 to 10 feet (2.4 to 3 meters) of water. During a 10-year flood, the crossing would be under 15 to 18 feet (4.6 to 5.5 meters); 10 to 22 feet (3 to 6.7 meters) with a 25-year flood; and 22 to 23 feet (6.7 to 7 meters) with a 50-year flood (USACE, 1996).

West of the creek, 100-year and 500-year floods would inundate portions of the golf course as well as the area near the helipad approach to the east bank of the creek.

Additionally, the helipad approach and the Naval and Marine Corps Reserve Center could suffer some low-level flooding as a result of a 500-year flood (USACE, 1996).

The USACE and the EPA define wetlands as those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. The United States Fish and Wildlife Service 1999 National Wetlands Inventory identified approximately 120 acres of wetlands (USGS, 1999). These wetlands are associated with the floodplain of Salado Creek or are hydrologically connected to the creek (USGS, 1999).

3.1.4.3 Groundwater

FSH is located in an area associated with the hydrologic unit known as the Edwards Underground Reservoir, or Edwards Aquifer, which is composed of the Comanche Peak, Edwards, and Georgetown Limestone formations (USACE, 1996). This aquifer extends along the Balcones Fault Zone from Kinney County through Uvalde, Medina, Bexar, and Comal Counties and terminates in Hays County. The formations of the Edwards Plateau form an extensive perched water table, upon which 17 cities and communities totaling approximately 1.5 million people depend for their water supply. San Antonio is the largest city in the United States that obtains its entire water supply from underground sources (U.S. Army, 1991a). FSH obtains its drinking water from five active wells that extend into the Edwards Aquifer to depths of 728 to 1,106 feet (222 to 337 meters). Records indicate no significant difference in the water from these five wells and, although the water is moderately hard, it is of good quality (USACE, 1996).

The Edwards Aquifer is divided into the drainage area, the recharge zone, and the artesian/reservoir zone (see Figure 3-4). The drainage area on the Edwards Plateau is about 4,400 square miles. Elevations range between 1,000 and 2,300 feet above msl. Water from rainfall runs off into streams or infiltrates the water table aquifer of the plateau.

Water table springs then feed streams that flow over relatively impermeable limestone until they reach the recharge zone. The recharge zone is a 1,500-square-mile area where highly faulted and fractured Edwards limestone outcrops at the land surface, allowing large quantities of water to flow into the aquifer through solution cavities that have developed along fractures in the limestone. Surface water reservoirs also contribute large amounts of water to the aquifer. Approximately 85 percent of the aquifer's recharge occurs when rivers and creeks cross the recharge zone and contribute their flow to the underground formation (Eckhardt, 1999). Surface water reservoirs such as Medina Lake contribute large amounts of water to the aquifer. Some recharge is from direct precipitation on the outcrop. Water in the artesian zone is confined between two relatively impermeable formations: the Glen Rose formation below and the Del Rio clay on top (see Figure 3-5).

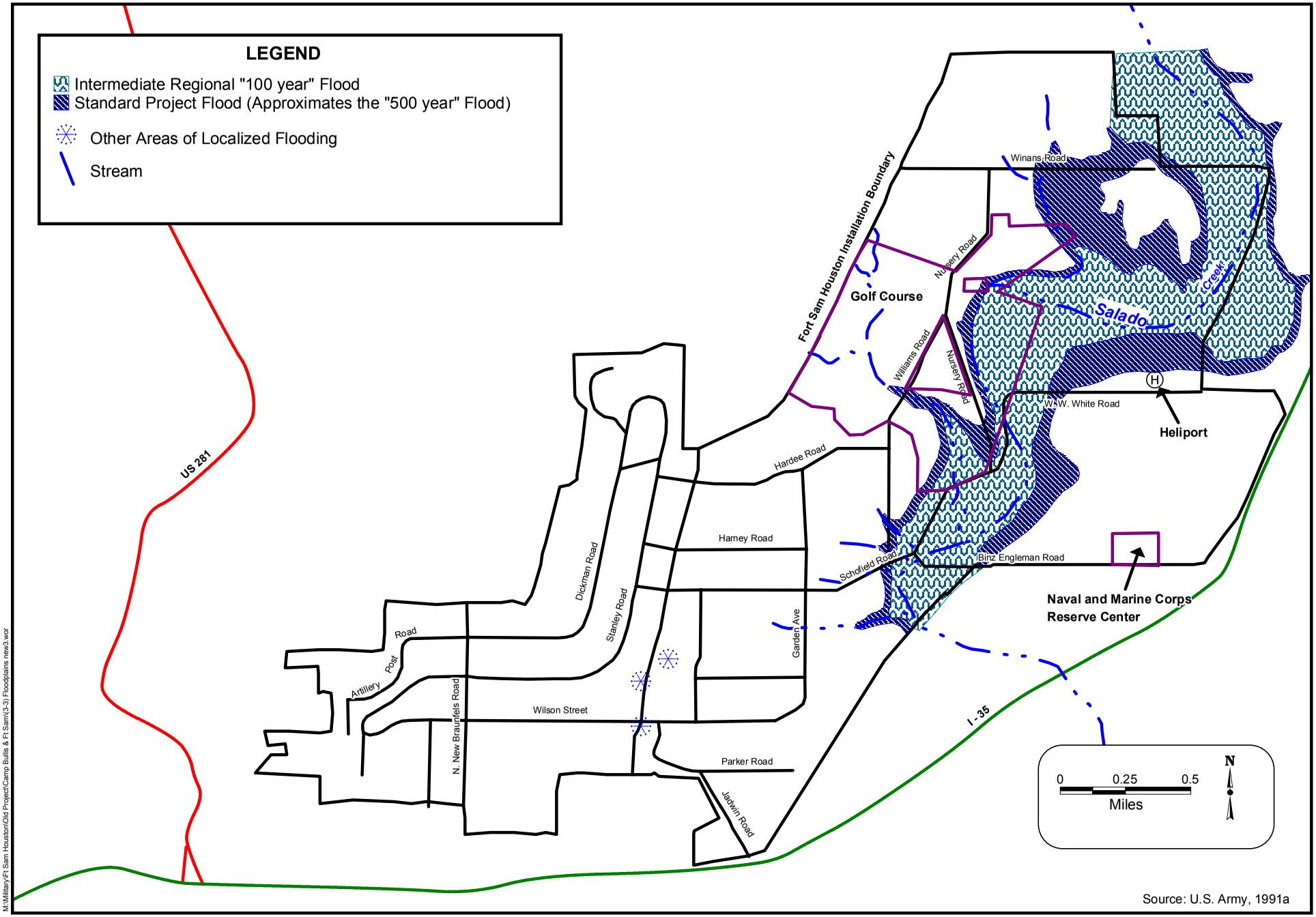


Figure 3-3 -- Areas of Flooding at Fort Sam Houston

FSH is located over a portion of the artesian zone from which it obtains its water supply. At various places downslope from the recharge zone, in the artesian zone, artesian wells and springs have sufficient hydraulic pressure to force water through wells and faults to the surface (U.S. Army, 1991a; Eckhardt, 1995b). Major natural discharge occurs at San Marcos Springs and Comal Spring, both of which are located northeast of FSH. San Antonio Springs and San Pedro Springs, south-southwest of FSH, are dry most of the time because Bexar County pumps large volumes of water out of the aquifer; however, the springs flow when the aquifer levels are high. Water generally moves through the aquifer from the higher elevations in the west toward the major discharge areas in the east (Pearson et al., 1975). A number of barrier faults prevent water in the various units of the aquifer from mixing. These faults, along with varying degrees of porosity and permeability of the limestones, control the movement of water in the aquifer. No major water quality or pollution problems have been experienced in the Edwards Aquifer. The only known degradation of the water quality is a natural phenomenon known as the “bad water line.” In a zone along the southern and eastern edges of the fresh water zone, the rock is denser and less permeable, decreasing the movement of water. In this zone, where aquifer water is in contact with the limestone for long periods, mineral solids from the surrounding rock are dissolved and the concentration of total dissolved solids (TDS) reaches 1,000 parts per million (ppm). At this point, the water is considered saline and is not potable (seawater is 33,000 ppm) (Eckhardt, 1999).

The movement of water in the Edwards Aquifer formation is highly complex and, although water easily enters the recharge zone, the subsurface drainage is generally inadequate to hold all the water that falls in large rain events. Recharge conduits and sinkholes are quickly filled with water and therefore the region is prone to flash flooding. Average annual recharge is approximately 640,000 acre-feet, but is highly variable.

Theoretically, there is enough water in the aquifer (potentially 25 to 55 million acre-feet [Maclay, 1981; Ogden, 1986]) to supply the region for 200 to 300 years, even if no additional recharge occurs. In reality, only a small portion of the water is retrievable because the majority of it is captured within the rock. Springflow, in the artesian zone, depends on the upper 5 to 10 percent of the formation. Essentially, when all the springs run dry, the aquifer may still be 90 to 95 percent full (Eckhardt, 1999).

Total annual water use data for Edwards Aquifer indicate that FSH uses a very small volume of water (0.91 percent of the water discharge) in comparison to the total volume withdrawn from the Edwards Aquifer by other larger water users and the volume discharged through natural outflows such as creeks and springs (GeoMarine, Inc., 1996a). Considering the increasing water needs of the area, FSH has implemented a Water Use Reduction Program. This program identifies the need for a comprehensive water use and conservation plan and a description of aquifer levels, spring flows, and associated management stages. Initially, this plan focused on measuring the water levels only in well J-17 (Well #AY-68-37-203). As aquifer levels or spring flows declined, as noted by measurements on the level of well J-17, different stages of water use reduction were mandated, each with a successive increase in restrictions and conservation procedures.

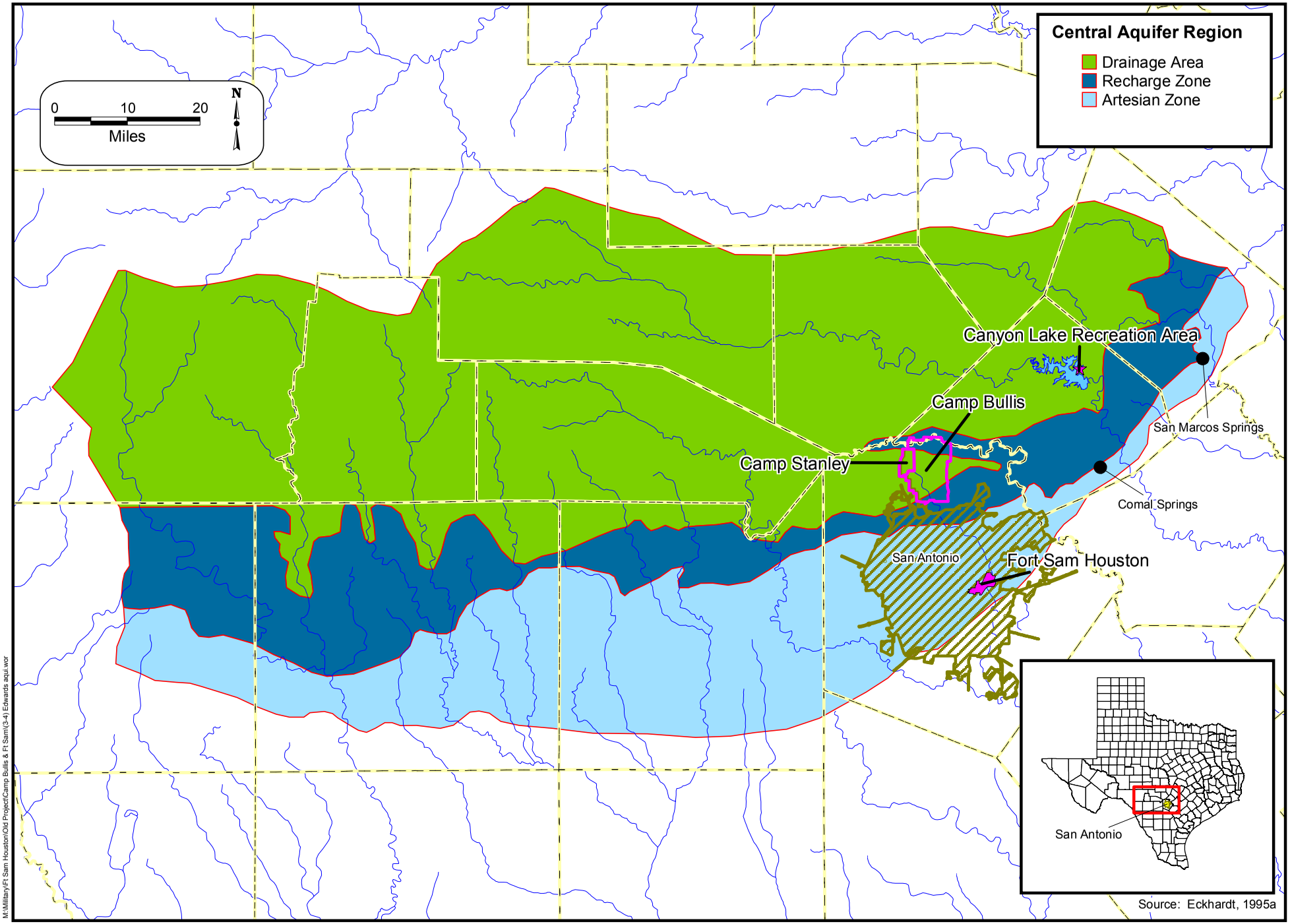
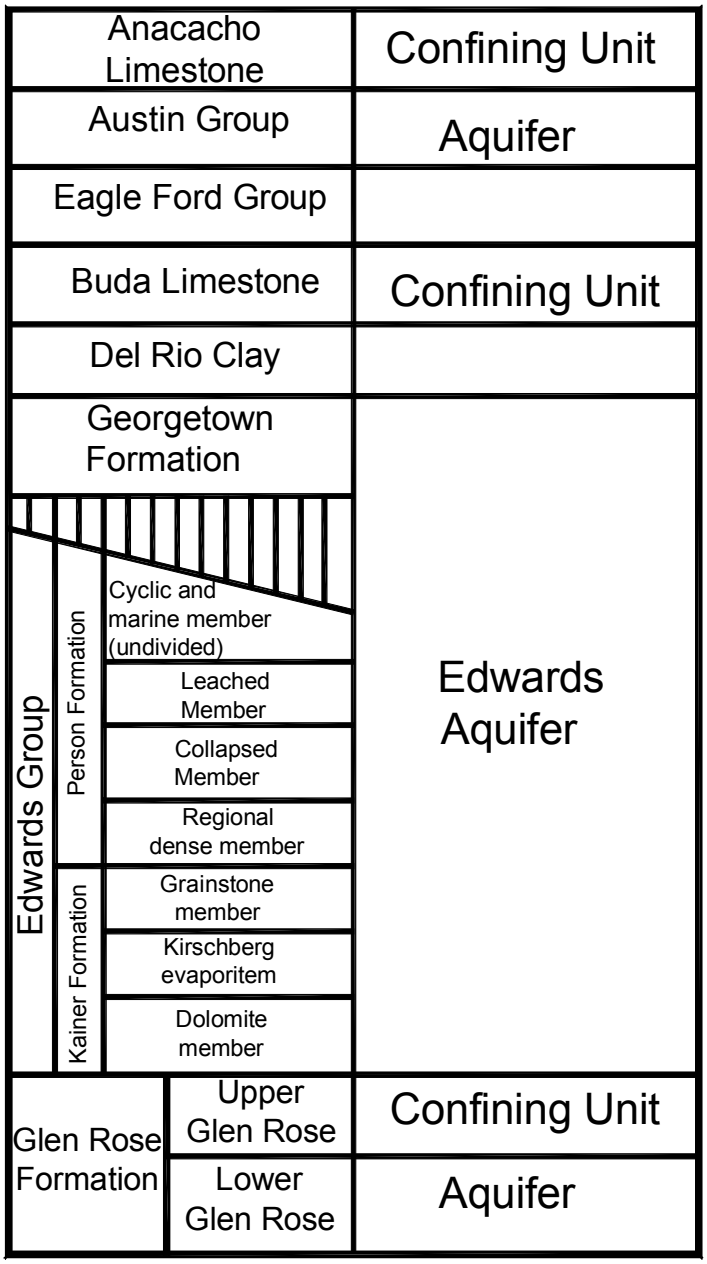


Figure 3-4 -- The Central Region of The Edwards Aquifer

Figure 3-5 The Cretaceous Stratigraphic Units Associated with the Edwards Aquifer



Source: Eckhardt, 1999.

On November 5, 1999, the United States Fish and Wildlife Service (USFWS) issued Biological Opinion 2-015-98-R-759 (USFWS, 1999) on the effects of Edwards Aquifer withdrawals due to military activities. This drought management plan takes into account the USFWS's concerns of relying solely on aquifer levels in the J-17 index well as the trigger for drought management stages. Instead, the USFWS recommends the use of triggers based on J-17, as well as springflow levels in Comal and San Marcos springs. DoD has agreed to the proposed drought management plan set forth in the Biological Opinion and detailed in Table 3-6. As aquifer levels and/or springflows decline, different stages of reduction are reached, each with successive increases in restrictions and conservation procedures (see Table 3-6). The Biological Opinion is provided in Appendix B.

Table 3-6 Water Use Reduction Program

Stage	Triggers*			Maximum Allowable Usage	
	J-17	Comal	San Marcos	Multiplier	Monthly Withdrawal
I	5 days where Level = 657.5 ft	5 days at or below 250 cfs	3 days at or below 80 cfs	1.7	Base usage
II	5 days where Level = 647.0 ft	5 days at or below 200 cfs	Any Stage I trigger, plus 3 days at or below 80 cfs	1.6	Base usage
III	5 days where Level = 642.0 ft	5 days at or below 180 cfs	Any Stage II trigger, plus 3 days at or below 80 cfs	1.4	Base usage
IV	5 days where Level = 640.5 ft	5 days at or below 160 cfs	Any Stage III trigger, plus 3 days at or below 80 cfs	1.3	Base usage
V	3 days where Level = 637.0 ft	3 days at or below 100 cfs	Any Stage IV trigger, plus 3 days at or below 80 cfs	1.185	Base usage

Source: USFWS 1999

1. Maximum Allowable Usage – The amount of underground water that a person is allowed to withdraw or supply.

2. Base Usage – For a primary user that is not a conjunctive user, base usage is the average monthly total of underground water usage for the three lowest months of November and December of 1995 and January and February of 1996. For a primary user that is a conjunctive user, base usage is the average monthly total of underground water usage for the three lowest months of November and December and the following January and February during each of the three consecutive 12-month periods preceding the start of the primary user's use of non-Edwards Aquifer water, which qualifies the primary user as a conjunctive user.

Legal and Regulatory Status of Edwards Aquifer

The Sierra Club filed a suit in 1991 against the Secretary of the Interior under the Endangered Species Act (ESA) of 1973 (Public Law 93-205) to protect the endangered and threatened species of the San Marcos and Comal Springs. As part of a 1 February 1993 Judgment (amended on 26 May 1993), the United States District Court for the Western District of Texas ordered the U.S. Fish and Wildlife Service (USFWS) to make determinations relative to minimum springflow and aquifer levels necessary to avoid the "take" or "jeopardy" of threatened or endangered species. To "take" a species is defined as: "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any conduct" and is an event that may pertain to one or more individuals of a species. The term "jeopardy" refers to a situation where the status of the entire species is in peril. As presented in the "San Marcos and Comal Springs and Associated Aquatic Ecosystems Recovery Plan," the minimum springflow needed to prevent take, jeopardy, or adverse modification of critical habitat was determined (USFWS, 1996).

The court also directed the state legislature to prepare a satisfactory plan to limit water withdrawals from the Edwards Aquifer to protect endangered species that rely on the springflows from the aquifer. In 1993, the state legislature passed Senate Bill 1477, which created the Edwards Aquifer Authority (EAA) to regulate groundwater withdrawal. Due to concerns about representation under the Voting Rights Act expressed by the U.S. Justice Department, the bill was declared void. In 1995, the state legislature passed House Bill 3189, amending Senate Bill 1477. This bill resolved the Voting Rights Act issues and again created the EAA. Implementation of Senate Bill 1477, as amended (House Bill 3189), allows the EAA to limit water withdrawal from the aquifer to 450,000 acre-feet per year until 31 December 2007 and to 400,000 acre-feet per year thereafter. However, the EAA has been challenged by legal actions questioning EAA's authority, structure, and rules. The Texas Supreme Court ruled the law constitutional in 1996, and the EAA's board issued proposed interim withdrawal permits and began operating the Critical Period Management Plan prescribed in the EAA rules. On 1 December 1998, the 126th District Court (Travis County) invalidated the proposed withdrawal permits and the Critical Management Plans. The EAA is expected to re-adopt rules and re-issue permits.

Although the operations at FSH use a very small percentage of the total aquifer discharge (0.91 percent), attention and planning continue regarding the use of water on the installation and any changes in base population. Additionally, FSH is constantly searching for ways to reduce the water draw from the aquifer (see Installation of Reuse Water Infrastructure, below). Refer to Section 3.1.5.3, Threatened and Endangered Species, for a detailed discussion of identified threatened and endangered species potentially affected by water levels in the Edwards Aquifer.

Installation of Reuse Water Infrastructure at FSH

In June 1999, following an environmental evaluation, FSH and the San Antonio Water System (SAWS) entered into a partnership in which SAWS agreed to construct approximately 36,000 feet of distribution pipeline connecting 11 cooling towers, four athletic field complexes, eight facility irrigation systems, and two golf courses on the installation to the SAWS reuse water system. This will reduce the need for FSH to use the Edwards Aquifer for those functions and will allow FSH to reduce its draw on the aquifer by approximately 820 acre-feet of water per year (FSH/SAWS, 1999).

3.1.5 Biological Resources – FSH

The ROI for biological resources includes Fort Sam Houston proper.

AR 200-3, Natural Resources-Land, Forest, and Wildlife Management, and the Sykes Act, 16 USC 470a et seq., as amended in 1997 (PL 105-85), require Army installations to develop and maintain Integrated Natural Resources Management Plans (INRMPs). The Integrated Natural Resources Management Plan Fort Sam Houston, Camp Bullis, and Canyon Lake Recreation Area, Texas (USACE, 1996) was completed in 1996 and is being updated. The INRMP provides a management program that guides activities on FSH and the CLRA to preserve the environmental and natural resources of each.

3.1.5.1 Flora

The land that is now FSH originally was part of the Blackland Prairie Biome, although the South Texas Plains and Edwards Plateau biota may also find their way into the area. This area is located where three distinctly different soil associations meet, and because of this edge setting it is likely that the original vegetation was quite diverse and abundant before the land was developed into the modern FSH. Little bluestem (Schizachyrium scoparium) grasses are considered the dominant climax species, while other grasses such as big bluestem (Andropogon gerardi), Indian grass (Sorghastrum avenaceum), switch grass (Panicum virgatum), Texas winter-grass (Stipa leucotricha), and side-oats grama (Bouteloua curtipendula) would also be found. Along the waterways, the grassland yielded to woodlands consisting of cedar elm (Ulmus crassifolia), netleaf hackberry (Celtis reticulata), cottonwood (Populus deltoides), and pecan trees (Carya illinoinensis). Some spiny shrubs of the South Texas chaparral may have been present on the southern portion of the installation (U.S. Army, 1991a).

The U.S. Army began developing the area approximately 100 years ago and has slowly expanded its facilities so that only the wooded and grassy area along the floodplain of Salado Creek (approximately 30 percent of the post) remains undisturbed habitat. The remainder of the installation is planted with landscape ornamentals and lawns. A U.S. Army study identified 155 plant species in the unimproved areas along Salado Creek (U.S. Army, Environmental Hygiene Agency, 1985).

Trees found on the installation are ash (Fraxinus spp.), live oak (Quercus virginiana), pecan, cedar elm, netleaf hackberry, honey locust (Gleditsia triacanthos), palms, and crepe myrtle. Mesquite (Prosopis glandulosa) is found in the Salado Creek bottomlands in association with hackberry and cedar elm. Lawns predominantly consist of Bermuda (Cynodon dactylon) or St. Augustine (Stenotaphrum secundatum) grasses (USAEHA, 1985).

3.1.5.2 Fauna

The original prairie supported herds of buffalo, antelope, deer, peccary, and numerous game birds. The urbanization, which occurred over approximately 100 years, has caused most of the larger and more sensitive animals to vacate the site. The present fauna can be divided into two regimes: species tolerant of built-up areas; and those that occur in the Salado Creek floodplain.

Species typical of the built-up areas include urban-tolerant species such as fox squirrels (Sciurus niger), house sparrows (Passer domesticus), rusty blackbirds (Euphagus carolinus), grackles (Quiscalus auiscula and Q. mexicanus), northern mockingbirds (Mimus polyglottos), and American robins (Turdus migratorius). The floodplain along Salado Creek supports a more diverse bird fauna, including nesting migrating, and wintering species. Species commonly observed in December 1998 include the white winged dove (Zenaida asiatica) and northern cardinal (Cardinalis cardinalis). Other species recorded included the great horned owl (Bubo virginianus), mourning dove (Zenaida macroura), ladder-backed woodpecker (Picoides scalaris), and Carolina chickadee (Parus carolinensis). The double-crested cormorant (Phalacrocorax auritus) and wood duck (Aix sponsa) were observed along the creek, and a large number of waterfowl and other water birds would be expected along Salado Creek throughout the year (U.S. Army, 2000a). Beaver (Castor canadensis), armadillo (Dasypus novemcinctus), striped skunk (Mephitis mephitis), cottontail rabbit (Sylvilagus floridanus), and opossums (Didelphis virginiana) inhabit the bottomlands. Fish species include black bullheads (Ictalurus melas), mosquitofish (Gambusia affinis), sailfin molly (Poecillia latipinna), warmouth (Lepomis gulosus), bluegill (Lepomis macrochirus), largemouth bass (Micropterus salmoides), and Rio Grande perch (Cichlasoma cyanoguttatum). Introduced species of mouthbrooders may also inhabit Salado Creek as it passes through the reservation (U.S. Army, 1991a).

3.1.5.3 Threatened and Endangered Species

No threatened or endangered species are known to inhabit Fort Sam Houston proper. Urban development activities over the last 100 years have resulted in the removal of suitable unique habitat that may support federally listed threatened or endangered animal and plant species. Fort Sam Houston is, however, within the range of several species designated by the USFWS as threatened or endangered (see Table 3-7). The golden-cheeked warbler (*Dendroica chrysoparia*) and the black-capped vireo (*Vireo atricapilla*) are both known to breed in the undeveloped areas surrounding FSH and at Camp Bullis. The whooping crane *(Grus americana),* southern bald eagle *(Haliaeetus leucocephalus leucocephalus),* and the American and Arctic peregrine falcons *(Falco peregrinus anatum* and *Falco peregrinus tundrius)* could all possibly use the more secluded sites at Fort Sam Houston for resting or feeding on their annual migrations, although none has been sighted. The ocelot *(Felis pardalis)* has been reported in the county, although not in such populated areas as the post (U.S. Army, 1991a; USACE, 1994).

Table 3-7 Threatened and Endangered Species Potentially Occurring at Fort Sam Houston

SPECIES	FEDERAL LIST		STATE LIST	
	E	T	E	T
Golden-cheeked warbler	•		•	
Black-capped vireo	•		•	
Whooping Crane, *Grus americana*	•		•	
Southern bald eagle, *Haliaeetus leucocephalus leucocephalus*	•			
American peregrine falcon, *Falco peregrinus anatum*	•			
Arctic peregrine falcon, *Falco peregrinus tundrius*			•	
Ocelot, *Felis pardalis*	•			
Widemouth blindcat, *Satan eurystomus*				•
Toothless blindcat, *Troglogianis pattersoni*				•
Comal blind salamander, *Eurycea tridentifera*				•

E – endangered T – threatened
Source: U.S. Army, 1991a; USACE, 1994.

While no federally endangered or threatened species are known to inhabit FSH or the CLRA, water use by the installation would impact those species that depend on the Edwards Aquifer. The USFWS issued a biological opinion based on its study of the effects of Edwards Aquifer withdrawals incidental to the combined ongoing activities and projected mission increases at military installations in San Antonio, Texas (USFWS, 1999). The USFWS Biological Opinion is presented in Appendix B.

Endangered and threatened species listed in the Biological Opinion include the endangered fountain darter (*Etheostoma fonticola*), San Marcos gambusia (*Gambusia georgei*), Texas wild rice (*Zizania texana*), Texas blind salamander (*Typhlomolge rathbuni*), Peck's cave amphipod (*Stygobromus pecki*), Comal Springs riffle beetle (*Heterelmis comalensis*), and Comal Springs dryopid beetle (*Stygoparnus comalensis*) and the threatened San Marcos salamander (*Eurycea nana*). The Biological Opinion specifically discusses how withdrawals from the aquifer in excess of the recharge rate may adversely affect the listed species due to reduced springflow volumes from the aquifer.

3.1.6 Land Use and Visual Resources – FSH

The ROI for land use is the Fort Sam Houston post itself.

3.1.6.1 On-Post Land Use

Fort Sam Houston covers approximately 3,150 acres on the eastern edge of the City of San Antonio. The base is bounded on the east and south by Interstate Highway 35 (IH-35), on the southwest by Mahncke Park and the San Antonio Botanical Gardens, and on the north and northwest by the San Antonio Country Club and the Terrell Hills neighborhood (U.S. Army, 1991b). The base has been divided into land use categories according to the dominant use in a particular area (see Figure 3-6). The easternmost portion of the post is devoted primarily to medical use and facilities. This area houses the newly built BAMC along with DCA support facilities. Directly to the west of BAMC, from Wilson to the southernmost point of the base, is a corridor of development primarily dedicated to services (utilities) and supply and warehousing. A large contiguous tract of land containing a 36-hole golf course, south of the Fort Sam Houston National Cemetery on Wurzbach Road, has been set aside for recreational land use forming a portion of the northern boundary. Other smaller recreation areas can be found throughout the base.

The central core of FSH comprises a variety of land uses. The majority of the on-post housing is located there, including officer family housing, noncommissioned officer family housing, troop housing, and bachelor enlisted and officers quarters intermingled with administrative, community support, and smaller recreation facilities. A large family housing corridor is located along the northern boundary of the post. Arthur McArthur Field is a long, contiguous tract of land extending northeast to southwest near the north boundary of the post. It is used as a parade ground and athletic field. Approximately one-half of the Arthur McArthur Field area is a National Historic Landmark District, with the remaining portion (previously designated as a National Conservation District) delineated as a Potential National Historic Landmark District (see Figure 3-7).

Three areas on the installation are categorized for aviation use. These areas are associated with helipads, where development and uses are restricted. Two of these are located next to the current BAMC and former Main Hospital.

FSH is an “open” installation, in that the public has vehicular and pedestrian access to the installation. The public uses much of the area for walking and jogging, but a permit or an agreement is necessary to use official recreation facilities. FSH has real estate outgrants (mostly as leases or permits) on about five percent of the installation with the San Antonio Water System, City Public Service, and the U.S. Government to use certain land or facilities for specific purposes (USACE, 1996).

The Installation Commander controls land use on FSH by applying a comprehensive Land Use Plan. The Plan divides the available land into land use categories, with attention given to historic properties and National Historic Landmark Districts (existing and potential). In addition, “visual zones” are imposed on the planning process as a key control measure to ensure that aesthetics are included in any decision affecting land use. Aesthetics and the visual zones are discussed in more detail in Section 3.1.6.2 and are displayed in Figure 3-8. The FSH Land Use Plan and the overall installation planning program are discussed in greater detail in the FSH PEIS (U.S. Army, 2000a).

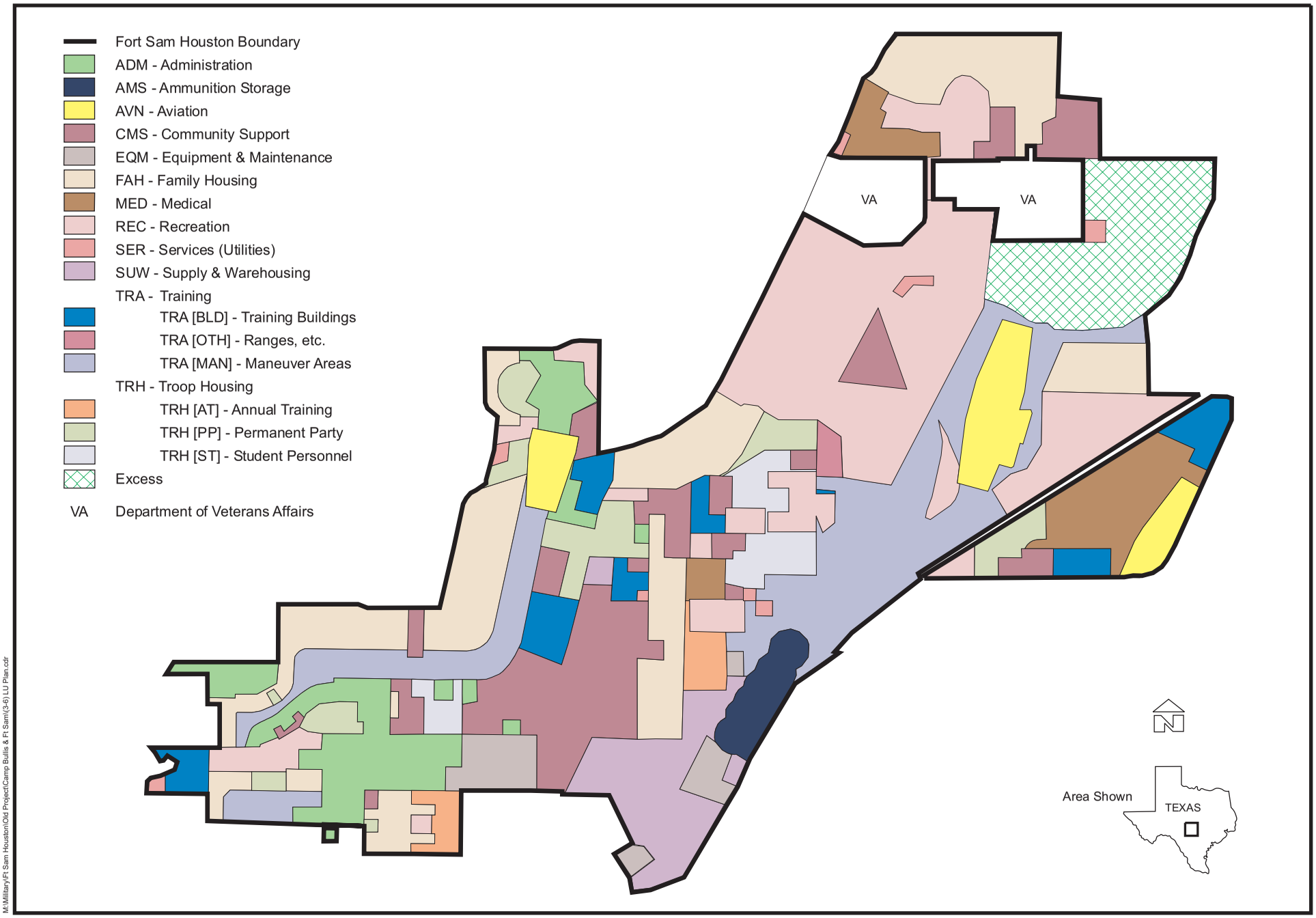


Figure 3-6 -- Fort Sam Houston General Land Use Plan

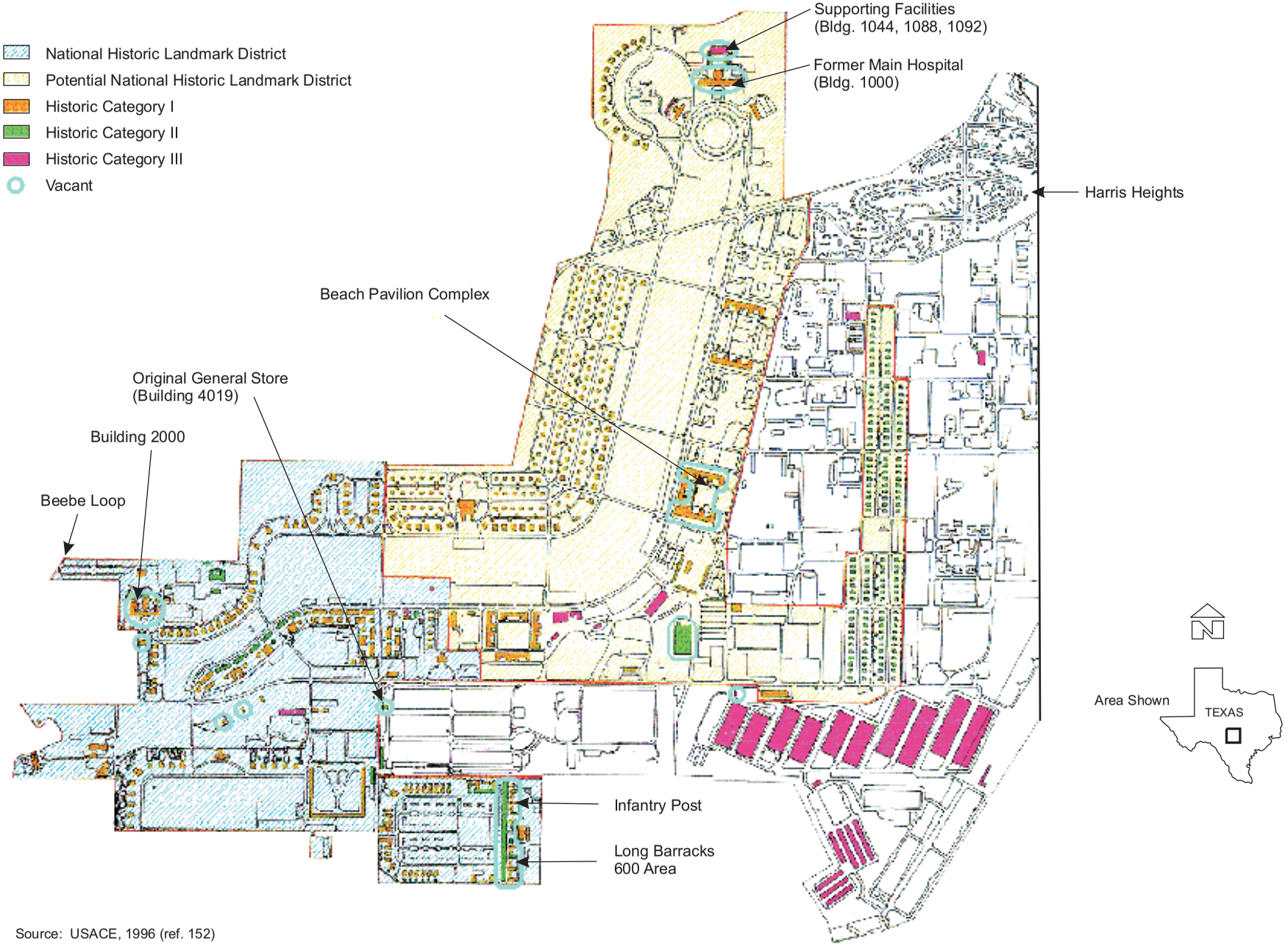


Figure 3-7 -- Fort Sam Houston Current and Potential National Historic Landmark District

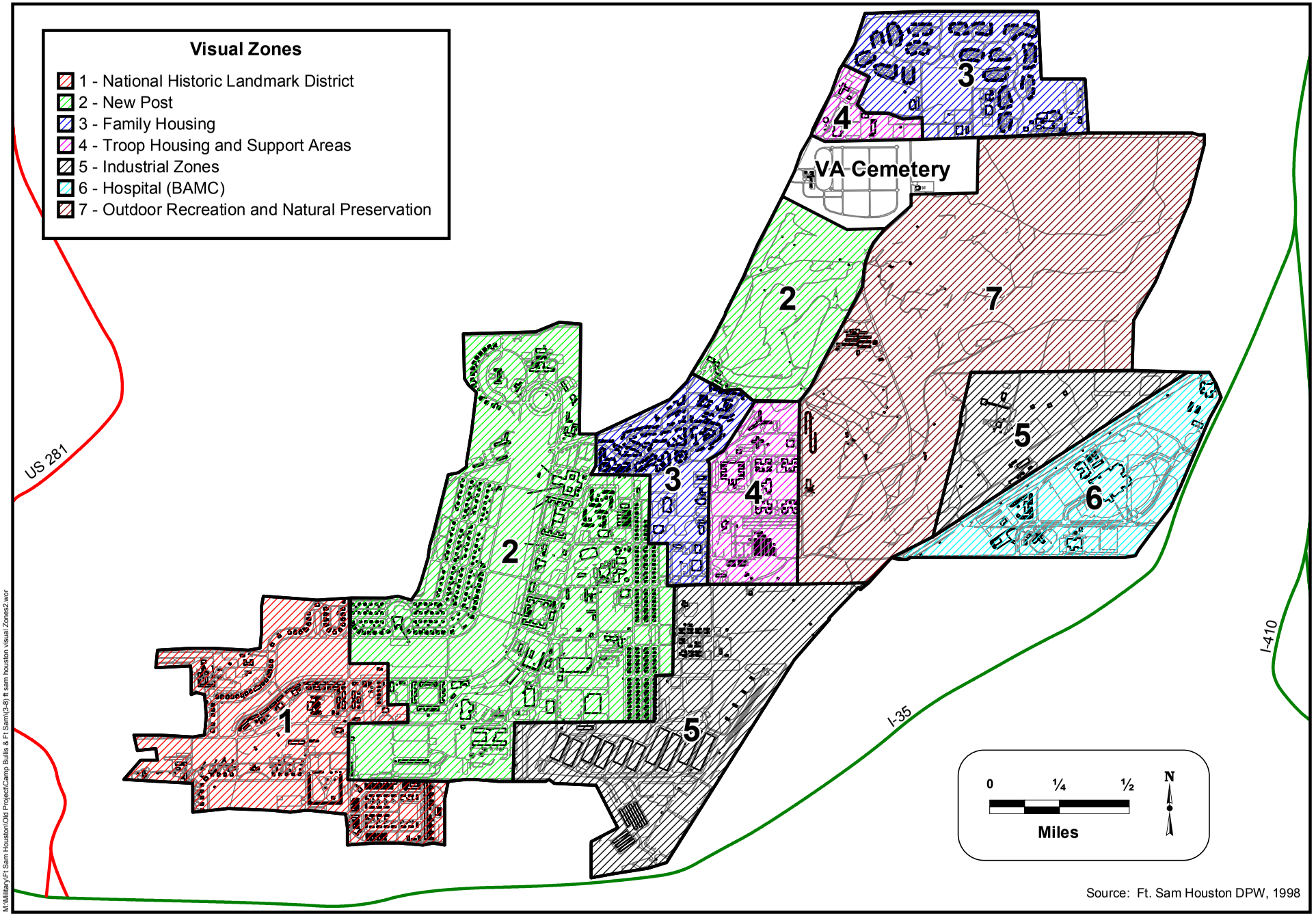


Figure 3-8 -- Fort Sam Houston Visual Zones

FSH encompasses 1,332 buildings totaling 11,791,719 square feet of space (see Table 3-8). The installation classifies each facility into one of 71 category groups (e.g., barracks, clinic, warehouse) according to the purpose of the facility. Requirements for a specific type of facility are based on current and identified future installation missions and population projections. FSH and Camp Bullis have requirements for more than 4,837,986 square feet of facility space beyond current installation assets in four facility category groups, and excess facility capacity of almost 2,695,000 square feet in 36 other facility category groups. These aggregated data reflect various types, ages, and conditions of facilities throughout FSH and Camp Bullis. Table 3-8 below provides the real property inventory for FSH for the second quarter of FY 1999.

Table 3-8 Real Property Inventory Data for Fort Sam Houston

2nd Quarter of FY 1999

Facility Type	Unit of Measure	Number of Facilities	Unit of Measure Total
Land	Acres	n/a	3,106
Buildings (total)	Square Feet	1,332	11,791,719
Buildings (owned)	Square Feet	1,303	11,487,802
Buildings (in-leased)	Square Feet	2	76,165
Buildings (other)	Square Feet	27	227,752
Dams	n/a	3	n/a
Vehicular Bridges	n/a	1	467
Pavements (less roads)	Square Feet	n/a	1,830,498
Roads (total)	Miles	n/a	250
Roads (paved)	Miles	n/a	148
Roads (unpaved)	Miles	n/a	102
Sewage Lines	Linear Feet	n/a	530,037
Landfills	n/a	12*	0
Central Heating Plants	n/a	10	169
Steam/Hot Water Distribution Lines	Linear Feet	n/a	25,635
Natural Gas Pipeline	Linear Feet	n/a	80,539

Source: USACE, 1999a.

Notes: * = Inactive.

Several major construction projects are in progress at FSH. Among them are construction of the BAMC replacement barracks, replacement of barracks B250, and repair and renovation of the Beach Pavilion. The FSH PEIS provides more details on the 29 construction projects that have been identified for FSH and the CLRA between FY 1999 and FY 2008. In addition to the projects mentioned, construction projects may occur in the Pershing Field and Salado Creek areas. The phased construction of the Harris Heights area is planned to be completed in 2007. Family housing and unaccompanied personnel housing could be constructed in Pershing Field. At the CLRA, recreation billeting has been planned for construction in FY 2001. The FSH PEIS provides additional details and inventories for existing and required facilities, construction projects, facilities proposed for disposal/demolition, and real estate actions that may occur at FSH and the CLRA (U.S. Army, 2000a).

As an alternative to demolishing family housing on-post, these facilities may be privatized. In February 1996, President Clinton signed into law the Defense Authorization Bill, PL 104-106. Provisions collectively known as the Military Housing Privatization Initiative (MHPI) are codified in 10 USC 2871 et seq. With current and anticipated appropriated funding levels, the Army cannot revitalize the existing housing stock, eliminate the housing deficit, and properly maintain and manage its existing military housing. By combining traditional military construction with the MHPI, the Army has an opportunity to address these needs by allowing the private sector to invest in the new construction and/or upgrade of facilities. The program is currently implemented as a pilot study at Fort Hood, Texas; Fort Lewis, Washington; and Fort Meade, Maryland.

Through a program known as the Residential Communities Initiative (RCI), the U.S. Army proposes to establish long-term business relationships with private-sector developers for the purpose of improving military family housing communities at FSH. Under this program, the Army would partner with a selected developer to jointly forge a Community Development and Management Plan that would be a blueprint for developing a specific residential community. Artillery Post Housing (Buildings 101 through 118) and Building 484 in the Wheaton, Graham, Dickman housing area, along with other FSH housing, are eligible for the RCI (see Figure 3-9). Additional NHPA and NEPA coordination would be necessary if Artillery Post housing or any other historic housing were turned over to a contractor as part of the RCI.

The new BAMC was constructed in 1996 and nearly 1.2 million square feet of space at the old BAMC (Building 1000) subsequently was vacated following the move to the new facility. The installation is addressing the issue of reuse of the old hospital building as well as the old hospital support facilities (Buildings 1044, 1092) and the Beach Pavilion Complex (Buildings 2371 and 2372) and others. Among the options being considered is a leasing initiative program involving the adaptive reuse of vacant facilities by DoD and/or other Federal agencies, Alternative 2.

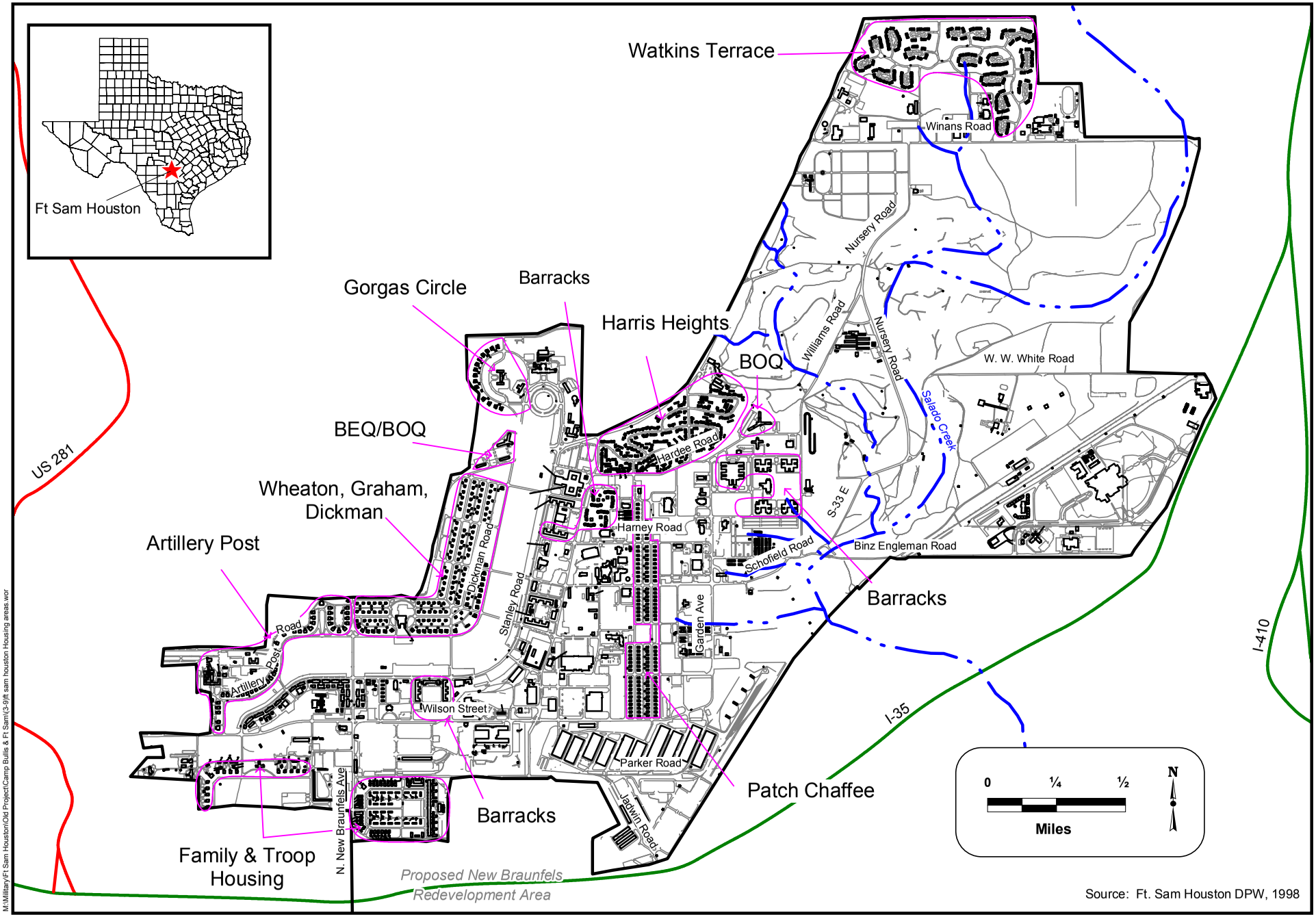


Figure 3-9 -- Fort Sam Houston Housing Areas

3.1.6.2 Aesthetics

FSH has provided for the maintenance of important visual resources on-post, such as view corridors, vegetation, and unique architectural styles. Planning officials have delineated the base into several "visual zones" in an attempt to describe the overall use and design quality of specific areas as well as to define design criteria applicable to the individual visual zones (see Figure 3-8). The *Installation Design Guide* is a comprehensive document that provides detailed recommendations as to the type of designs appropriate to maintain designated historic and landmark areas as well as other visual zones. Moreover, the *Installation Design Guide* provides guidelines that anticipate continuity in future land use and future land development on-post (U.S. Army, 1991b). The Public Works Business Center (Environmental and Natural Resources Division; Business Services Division) also provides leadership in managing the aesthetic characteristics of the built and natural environment. FSH has an *Historic Landscape Master Plan* designed to provide guidance for future landscape planning that will enhance the historic character, improve the public image, and conserve water (USACERL, 1995). Both documents subdivide the installation into areas or zones that have unifying qualities. In the landscape plan, these largely reflect progressive enclaves of development on the installation. In the *Installation Design Guide*, mission activities and geographic aspects also define development zones.

3.1.7 Socioeconomics – FSH

The socioeconomic resources of the affected region are characterized in terms of population, employment, income, housing, and community services. The ROI for the socioeconomic analysis is based on a geographic area determined to be associated with FSH in terms of housing and employment. This area is the San Antonio MSA, which includes the City of San Antonio and FSH, and the counties of Bexar, Comal, Guadalupe, and Wilson.

3.1.7.1 Population

San Antonio Metropolitan Statistical Area

The 1990 Census reported the MSA population to be 1,324,749. By 1999, this number climbed to 1,552,124, an increase of 17.2 percent. Additional growth of 16.2 percent by the year 2009 is expected to increase the total MSA population to an estimated 1,802,960 (see Table 3-9).

Bexar County, which includes the City of San Antonio, has seen consistent increases in population presumably due to the increasing regional importance of San Antonio. From 1990 to 1999, Bexar County grew from a population of 1,185,395 to 1,361,945, an increase of 14.9 percent. Bexar County is expected to continue this rate of growth into the year 2009, with an estimated growth of 14.3 percent between 1999 and 2009. Comal, Guadalupe, and Wilson Counties experienced more significant population increases from 1990 to 1999 (45.7 percent, 27.0 percent, and 42.5 percent, respectively), and they show growth rates between 1999 and 2009 of 34.8 percent, 23.5 percent, and 33.0 percent, respectively.

Table 3-9 Population Projections: San Antonio MSA

Place	1990	1995	1999	2009	% Change 1999-2009
Bexar County	1,185,395	1,296,735	1,361,945	1,556,490	14.3
Comal County	51,832	64,155	75,520	101,783	34.8
Guadalupe County	64,873	72,632	82,391	101,761	23.5
Wilson County	22,650	27,291	32,268	42,926	33.0
San Antonio MSA	1,324,749	1,460,809	1,552,124	1,802,960	16.2

Source: U.S. Census Bureau, 1990; U.S. Army, 1991a; AGS, 2000.

Table 3-10 illustrates the age distribution and population characteristics of the San Antonio MSA. The 45-64 age group represents the largest percentage of the MSA population, with Comal County having the largest at 31.6 percent. At least one-quarter of the population of each of the counties within the MSA is more than 45 years old, indicating a trend toward a more stable, mature population composed mainly of retirees and the aged. Additionally, an increase in these age groups indicates possible reduced future economic activity as more people move out of the labor market into retirement.

Table 3-10 1999 Population Characteristics (%) San Antonio MSA

RACE	Bexar County	Comal County	Guadalupe County	Wilson County	Texas
White	38.5	66.5	57.3	55.3	55.3
Black	6.4	2.8	6.2	2.9	10.8
Hispanic	53.5	29.8	35.4	41.3	31.5
Other	1.6	0.9	1.2	0.6	2.4
AGE GROUP					
Age 0-4	8.2	6.7	7.6	7.7	7.9
Age 5-14	14.8	12.9	14.7	16.3	14.6
Age 15-24	16.7	12.7	14.8	14.6	16.1
Age 25-44	23.5	19.7	21.5	20.7	24.1
Age 45-64	26.5	31.6	29.0	27.7	27.0
Age 65 plus	10.2	16.4	12.3	13.0	10.3
Median Age (1999)	30.7	37.8	33.4	33.0	31.4

Source: AGS, 2000.

Fort Sam Houston

Population profiles for FSH displayed in Table 3-11 are based on the September 1999 edition of the Army, Stationing and Installation Plan (ASIP) generated by the Installation Planning Office at FSH (U.S. Army, 1999a). The ASIP report reflects the authorized populations of all units, activities, students, and other tenants at FSH and Camp Bullis. The September 1999 edition of the ASIP shows that the FY 1999 authorized population included 11,161 military personnel and 7,217 civilians affiliated with Fort Sam Houston and Camp Bullis. Included in the military total is the authorized annual AMEDDC&S student load. These numbers also include other Army, Navy, Marine Corps, Federal and State Government agencies, as well as non-government agencies affiliated with FSH. The aggregate population reflecting all authorized personnel at FSH and Camp Bullis for FY 1999 totals 18,373.

The ASIP has estimated the population of Fort Sam Houston and Camp Bullis combined through the year 2005. The plan shows that the base population is expected to decrease 3.6 percent from 1999 to 2005.

Table 3-11 Fort Sam Houston* Population Profile, FY 1999 – FY 2005

Element	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	% Change 1999-2005
Military Personnel								
Officers	2,835	2,688	2,739	2,742	2,741	2,741	2,741	-3.4%
Warrant Officers	94	72	73	73	73	73	73	-28.8%
Enlisted	8,232	8,027	8,470	8,336	8,303	8,303	8,303	0.9%
Total Military	11,161	10,787	11,282	11,151	11,117	11,117	11,117	-0.4%
Non-military Personnel								
DoD Civilians	5,052	4,615	4,457	4,455	4,456	4,454	4,454	-13.4%
Other Civilians	2,165	2,166	2,166	2,167	2,167	2,167	2,167	0.09%
Total Civilians	7,217	6,781	6,623	6,622	6,623	6,621	6,621	-9.0%
Total Population	**18,378**	**17,568**	**17,905**	**17,773**	**17,740**	**17,738**	**17,738**	**-3.6%**

Source: U.S. Army, 1999a.

* This table also includes the military and civilian population associated with Camp Bullis, Texas.

3.1.7.2 Military Economic Participation in the San Antonio MSA

The San Antonio Chamber of Commerce sponsored a study in 1987 that estimated that the "five military installations and sub-unit locations (Lackland Air Force Base [AFB], Randolph AFB, Fort Sam Houston [FSH], Kelly AFB, and Brooks AFB), plus other categories of military pay sources, total approximately 28 percent of the effective buying income of the individuals in the metropolitan area." The report showed total pay of $2.2 billion, local purchases of $376 million, and other economic impacts of $64 million for a total impact of $2.64 billion by the military in the MSA. The other economic impacts included construction contracts, Federal Education Impact funds, tuition assistance, claims reimbursement, and military family housing (USACE, 1993b).

A 1999 update to the 1987 report estimated that the five military installations and sub-installations contributed a combined total military, civilian, and National Guard/Reserve payroll of $3.51 billion in 1999. This number includes $1.53 billion in retired military pay and civilian annuities. Combined with local military purchases of $265 million and $163 million in other economic activities and impacts (including construction contracts, Federal education impact funds, tuition assistance, and claims reimbursements), the military accounted for a total impact in the San Antonio region of about $3.94 billion (PAO, 1999).

The share attributable to FSH (including Camp Bullis), as reflected in the 1999 statistics, includes approximately $555 million in payrolls (including civilian, military, and National Guard/Reserves). Also, FSH contributed $67 million to the region through local purchases, and approximately $72 million in other funding, including construction contracts, Federal education impact funds, tuition assistance, medical treatment subsidies, and claims reimbursements. These statistics represent a total economic impact by FSH on the San Antonio region of approximately $695 million in 1999.

3.1.7.3 Employment and Income

San Antonio Metropolitan Statistical Area

Table 3-12 displays labor statistics for the San Antonio MSA, with emphasis on military labor. According to estimates, the total labor force for the San Antonio MSA was 767,392 people. Bexar County constituted a major portion of this total, with a labor force of 673,056. This large labor force is due primarily to the presence of the City of San Antonio, as well as the five military bases (Lackland AFB, Randolph AFB, FSH, Kelly AFB, and Brooks AFB) in Bexar County. The military bases accounted for 23,368 persons out of the total labor force in Bexar County. In all, the armed forces labor pool in Bexar County accounts for 3.5 percent of the total labor pool; in the whole MSA, military labor accounts for 3.2 percent of the labor pool. Table 3-13 displays unemployment rates for each of the counties making up the San Antonio MSA and the MSA as a whole. Bexar County experienced the highest unemployment rate for the MSA from 1997 to 1999. Unemployment rates for every county in the MSA dropped between 1997 and 1999, over which time the unemployment rate for the MSA as a whole was lower than the Texas average. Furthermore, none of the county unemployment rates for these years exceeded the respective rates for the state as a whole.

Table 3-12 San Antonio MSA and Area Labor Force: 1999

		Civilian Labor Force			Armed Forces	
	Total Labor Force	Total	Employed	Unemployed	Total	% of Total Labor Force
Bexar Co.	673,056	649,688	612,759	36,929	23,368	3.5
Comal Co.	37,612	37,481	35,970	1,511	131	0.3
Guadalupe Co.	41,778	41,112	39,331	1,781	666	1.6
Wilson Co.	14,946	14,867	14,267	600	79	0.5
MSA Total	767,392	743,148	702,327	40,821	24,244	3.2

Source: AGS, 2000.

Table 3-13 Unemployment Statistics for San Antonio MSA and Texas

Unemployment Rates			
Area/County	**1997**	**1998**	**1999**
Bexar County	4.2	3.8	3.2
Comal County	3.0	2.7	2.5
Guadalupe County	3.0	2.5	2.5
Wilson County	3.0	2.9	2.6
MSA Total	4.1	3.7	3.1
Texas	5.4	4.8	4.6

Source: Texas Workforce Commission, 2000.

In 1999, the economy of the San Antonio MSA consisted of the following eight major industry sectors: services (38.2 percent), wholesale/retail trade (23.5 percent), manufacturing (including non-durable and durable goods) (9.3 percent), finance (8.3 percent), transportation/utilities (6.7 percent), construction (6.2 percent), government (7.7 percent), and mining, which at 0.4 percent makes up a fraction of the remaining total. The San Antonio MSA was higher than the State averages in services (36.1 percent), wholesale/retail trade (23.3 percent), finance (7.2 percent), and government (4.7 percent).

Again, the larger government sector in Bexar County is due primarily to the five military facilities in the area. The San Antonio MSA is a regional center of finance, business, and trade distribution, primarily due to its geographic location. White collar occupations are higher in Bexar County by percentage than in Texas as a whole. Table 3-14

displays the employment distribution data for the MSA, Texas, and the individual counties within the MSA.

Table 3-14 Non-Agricultural Industry Employment Distribution (percentages): 1999

Sector	Bexar County	Comal County	Guadalupe County	Wilson County	MSA Totals	Texas
Mining	0.3	1.0	0.9	1.4	0.4	1.9
Construction	5.9	8.1	6.6	12.3	6.2	6.9
Manufacturing	8.4	13.9	18.3	10.2	9.2	13.9
Transportation/Utilities	6.6	7.2	6.4	10.1	6.7	7.5
Wholesale/Retail Trade	23.5	22.4	24.3	22.2	23.4	22.8
Services	38.7	36.1	31.7	32.1	38.1	35.4
Finance (Insurance, Real Estate)	8.6	6.9	5.4	5.9	8.3	7.0
Government	8.0	4.4	6.4	5.8	7.7	4.6

Source: AGS, 2000, 1990.

The U.S. Census Bureau estimated 1997 poverty rates (percentages) in Bexar (18.5), Comal (10.4), Guadalupe (15.3), and Wilson (15.2) Counties. In comparison, approximately 16.7 percent of the total Texas population fell below the poverty line in 1997 (U.S. Census Bureau, 2000).

Income can be viewed in several different ways, each providing a broad look at the general affluence of a region and its population. Per capita income levels, for instance, are directly correlated with the growth of retail sales and the service sector of an economy. The San Antonio MSA had a per capita income level of $16,406 in 1999. No counties in the MSA exceeded the statewide level of $17,549 in 1999. The median household income for families based on 1999 estimates includes all wage earners within a single household. The median household income for the counties within the San Antonio MSA, the MSA as a whole, and the State of Texas are shown in Table 3-15.

Table 3-15 Income Statistics for the San Antonio MSA and Region: 1999

Area/ County	Total Number of Households*	No. of Family House-holds	No. of Non-Family Households	Median Household Income	Per Capita Income
Bexar Co.	484,738	347,768	136,970	$34,553	$16,556
Comal Co.	29,030	21,783	7,247	$37,528	$17,336
Guadalupe Co.	29,691	22,919	6,772	$34,843	$14,727
Wilson Co.	10,961	8,894	2,067	$29,488	$12,162
MSA	554,420	401,364	153,056	$34,776	$16,406
Texas	7,287,094	5,158,145	2,128,949	$36,940	$17,549

Source: AGS, 2000.

* Total Number of Households = Family Households + Non Family Households

Total personal income is normally used to measure a region's overall economic health. According to the Bureau of Economic Analysis estimates, total personal income for the San Antonio MSA was $21.7 billion in 1990 with an estimated increase in 1998 to $36.7 billion. The largest contributor to the overall totals for personal income in the MSA is Bexar County. In 1998, Bexar County accounted for $32.3 billion of the MSA's personal income total. Bexar, Comal, Guadalupe, and Wilson Counties showed increases of 65.6 percent, 114.8 percent, 81.5 percent, and 100.7 percent, respectively, between 1990 and 1998 (BEA, 2000).

3.1.7.4 Housing

San Antonio Metropolitan Statistical Area

Estimates show that 604,609 housing units were within the San Antonio MSA in 1999. Of this total, Bexar County had 528,349 units, or 87.4 percent of the total. Wilson County had the fewest at 11,834 units, with Comal and Guadalupe Counties having 32,122 and 32,304 units, respectively. Table 3-16 provides additional data on housing for the San Antonio MSA.

Table 3-16 Housing Characteristics: 1999

Characteristics	San Antonio MSA				
	Bexar County	Comal County	Guadalupe County	Wilson County	MSA Totals
Total Housing Units	528,349	32,122	32,304	11,834	604,609
Owner Occupied Units	290,978	22,016	22,065	9,025	344,084
Renter Occupied Units	193,760	7,014	7,626	1,936	210,336
Vacant Housing Units	43,611	3,092	2,613	873	50,189

Source: AGS, 2000.

Fort Sam Houston

Fort Sam Houston provides a variety of different housing options to support families, troops, and guests on post. Table 3-17 summarizes the housing available at Fort Sam Houston.

Table 3-17 Housing at FSH as of December 1999

Housing Type	Total Number of Units
Family Quarters	965
Guest Housing	150
Transient Housing	672
Troop Billets	6,196

Source: (U.S. Army, 2000a).

The Public Works Business Center-Housing Services is responsible for the oversight of housing stock at FSH. Their primary goal at this time is to reduce or eliminate the current on-post housing shortfall of approximately 400 units. The current waiting list for on-post housing includes approximately 850 eligible families. The majority of these families reside in the area surrounding FSH. The stock of vacant rental properties and units for sale within the commuting area around FSH is adequate to meet housing needs (see Table 3-16). The phased demolition of houses in Harris Heights may contribute to the shortfall in on-base family housing.

Section 3.1.6.1 discusses two innovative programs designed to improve and expand military housing through privatization. The programs, known as the MHPI and the RCI, are being analyzed for possible implementation at FSH to deal with the installation's shortfall of family housing and as an alternative to disposal and demolition of existing housing stock.

3.1.7.5 Community Services and Education

FSH provides a variety of services to its personnel on post. One of the more recent and prominent resources is the new BAMC. This facility affords users state-of-the-art medical facilities and greater capacity. The Fire and Emergency Services Division at FSH provides necessary fire and rescue services on post. This division also provides fire and rescue resources to the surrounding San Antonio community. In addition, FSH continues to provide helicopter service to critically injured civilians when requested (PAO, 1996a).

The four-county San Antonio MSA has 41 public school districts and 499 schools. Total enrollment at these schools, including the three FSH schools, was 297,193 for the 1999-2000 school year (Texas Education Agency, 2000). There is no known problem with overcrowding within any of the regional schools.

Children who live on post, or are expected to move on post within a given school year, attend one of three schools in the FSH Independent School District (ISD). This district consists of Robert G. Cole Junior/Senior High School, FSH Elementary, and a Special Education Cooperative. Enrollment at these schools was 450, 777, and 5, respectively, for the 1999-2000 school year (Bolin, 2000).

In 1999-2000, enrollment at the elementary school (777 students) approached the maximum occupancy of approximately 800 students. The high school has not yet reached its capacity and has maintained a relatively stable enrollment since the 1994-1995 school year. Children of affiliated personnel who live off post are enrolled either in an area public school or in a private institution. The Federal Government provides "impact aid" to the applicable school district to subsidize the education of children affiliated with a military installation (Ramsdell, 1996).

3.1.8 Cultural Resources – FSH

Cultural resources are physical evidence of past and present habitation that can be used to reconstruct or preserve the story of human presence in an area. Cultural resources consist of structures, sites, artifacts, and any other relevant information. Management of cultural resources involves planning and executing programs that identify, preserve, and maintain (or, in some cases, that demolish and mitigate) all archaeological and historic properties in compliance with the National Historic Preservation Act (NHPA) of 1966 and the Archaeological and Historic Preservation Act (AHPA). Numerous other laws, Executive Orders, and Army regulations also pertain to this subject area and can readily be found in the FSH Cultural Resources Management Plan (CRMP) (Geo-Marine, 1996c).

The NHPA and Executive Order 11593 require Federal agencies to identify, survey, and nominate all properties eligible for listing in the National Register of Historic Places (NRHP) on federally owned or controlled lands. According to Army policy, all installations are required to locate, identify, and maintain all buildings, structures, objects, sites, and districts eligible for inclusion on the NRHP. Installation commanders are required to prepare nomination forms and forward them to the State Historic Preservation Officer (SHPO) for signature. If questions arise as to whether a property is eligible for the National Register, the installation commander or the SHPO may request that the Secretary of the Interior make an eligibility determination. The Secretary is

responsible for establishing standards and advising Federal agencies on the preservation of historic properties listed on, or eligible for, the NRHP.

FSH maintains a list of proposed construction projects as well as a list of those demolition projects scheduled through the year 2065. Some of these properties scheduled for demolition are listed, eligible, or potentially eligible for inclusion on the NRHP. The FSH PEIS comprehensively addresses the property management and demolition plans for FSH, including the cultural resource aspects of pertinent assets (U.S. Army 2000a).

The ROI encompassed by the cultural resources under the control of FSH includes FSH proper, as well as the local area surrounding FSH.

3.1.8.1 Prehistoric and Historic Archaeological Resources

The cultural history of central Texas, from approximately 10,000 BC to the present, is summarized in the FSH CRMP (Geo-Marine 1996c). It also discusses Native American cultural history in the area, and provides a site-specific historic overview of the FSH Military Reservation.

Archaeological studies have been performed at FSH since 1974, when a prehistoric site was discovered in the northeastern portion of the installation. In 1977, the Center for Archaeological Research at the University of Texas, San Antonio began an archaeological and historical survey of both FSH and Camp Bullis. These and subsequent surveys, as well as recorded historic and prehistoric assessments of the sites, revealed degradation of the resources due to 20th-century military activities. Seven archaeological sites containing both prehistoric and historic components have been identified on FSH; however, none is considered eligible for the NRHP due to their disturbed nature (Geo-Marine, 1996c). Three archaeological sites were identified in the general area of the new BAMC construction: the Herman Eisenhauer home (occupied from 1885 to 1917); an abandoned landfill (used from 1918 to 1942); and a prehistoric occupation remains. None of the sites was directly affected by the BAMC construction. The exact location of each archaeological site is concealed in order to discourage unauthorized relic collecting and/or vandalism (Geo-Marine, 1996c).

These investigations constitute approximately a 90 percent survey of the unimpacted lands within the boundaries of FSH and, according to current research for the installation, satisfy the requirements for an intensive archaeological survey of the entire post. Historical documentation, geoarchaeology, and subsurface testing have revealed that extensive disturbances of sediment deposits along Salado Creek in FSH have made the preservation of in situ cultural materials unlikely (Geo-Marine, 1996c).

3.1.8.2 Architectural Resources

FSH is rich in architectural resources and has dedicated significant effort toward the identification, preservation, and management of these resources. Of importance to the management of resources at FSH is a 1991 Programmatic Agreement (PA) that was amended in 1997. The agreement was entered into by the Department of the Army, the Advisory Council of Historic Preservation, the Texas State Historic Officer, and interested persons concerning the continued operation, maintenance and development of FSH (and Camp Bullis) and the effect these activities may have on historic properties. The PA addresses FSH's responsibilities concerning the potential effect on historic

properties of the continued operation, maintenance, and development of FSH installation responsibilities regarding the maintenance and treatment of architectural historic properties pursuant to the NHPA and Army regulations and procedures to be followed in the case of proposed demolition actions. The PA is discussed in detail in the FSH PEIS (U.S. Army, 2000a).

FSH has an active cultural resource management program. In implementing the CRMP (U.S. Army, 1996c), three architectural surveys have been undertaken at FSH and a database for FSH of known architectural resources has been prepared. In 1980, the Historic American Buildings Survey (HABS) Level IV building and structure evaluation documentation was completed for 1,945 resources by the USACE, Fort Worth District. In 1993, an NRHP assessment of 1,917 buildings was undertaken using the Public Works Business Center Building Information Schedule. A survey in 1997 clarified the 1993 survey information and determined NRHP and NHLD eligibility for 1,427 architectural resources dating from 1876 to 1946. Of these resources, 760 architectural resources and 13 landscape features were determined to be eligible for the NRHP: 271 were located within the NHLD and dated primarily from 1876 to 1930; 439 were located within the potential NHLD and dated primarily from 1931 to 1946; and 50 were located throughout the installation. One landscape feature and 667 buildings were determined ineligible for listing on the NRHP (U.S. Army, 2000a).

The majority of the NRHP eligible resources at FSH form parts of enclaves that are united historically or aesthetically by plan or physical development. These enclaves, or districts, reflect an arrangement of historically or functionally related properties. Such districts may encompass several interrelated activities, such as an area that includes industrial, residential, or commercial buildings. FSH has two such areas: the National Historic Landmark District (NHLD), encompassing the older pre-1930 section of the post, which is currently listed on the NRHP; and the post-1930 to 1946 portion of the installation, previously known as the National Conservation District, but which is currently recognized as potentially eligible for inclusion in the NRHP as a second NHLD. It is referred to as a "potential NHLD" (see Figure 3-7).

The designation of these two areas recognizes their historical, architectural, and cultural significance. Both the designated District and the potential NHLD were established to recognize and protect buildings and structures that are of national significance. Principally, the existing NHLD was established by evaluating the entire old post sections of the Quadrangle, Staff Post, Infantry Post, Artillery Post and Cavalry Post as a unit representative of a significant period of American history. Similarly, the area of the potential NHLD, also known as the "New Post," was declared a "historic register conservation district" because it is believed to hold significance to the history of the region and to FSH by virtue of its architecture and its contributing history from 1931 through 1946 (Geo-Marine, 1996c).

To date, four historic properties at FSH have been listed on the NRHP: the Quadrangle (Building 16); the Clock Tower (Building 40); the Gift Chapel (Building 2200); and Pershing House (Quarters 6). Six significant landscapes within the historic district have been identified as requiring special attention: the Quadrangle; the Staff Post; the Infantry Post; the Cavalry and Artillery Parades; the New Post; and the New Post East. Thirteen significant historic landscape features associated with the design and function of FSH have also been identified (Geo-Marine, 1996c).

3.1.9 Utilities/Infrastructure – FSH

Utility privatization is being pursued as a result of the Defense Reform Initiative (DRID) (DoD, 1997). The Army's long-term objective is to privatize all utilities by 30 September 2003, unless uneconomical or proscribed for unique security reasons. Privatization is accomplished by transferring installation utility infrastructure to a private/public sector organization that takes over the responsibility to own, maintain, repair, and eventually dispose of and replace the systems to meet current and future Army requirements. Table 3-18 presents the schedule for privatization of utilities at FSH (U.S. Army, 2000a).

Table 3-18 Utilities Privatization Schedule

Utility	Date of Privatization
Natural Gas	September 1999
Electricity	September 2000
Water/Sewer	August 2001

Source: U.S. Army, 2000a

With the exception of the natural gas system, which is owned and maintained by City Public Service (CPS), FSH owns and maintains all utility equipment at FSH. This includes electricity, drinking water, and sanitary sewer attachments. The CPS supplies energy for electrical and heating needs at FSH. The post operates its own water production, storage, and distribution system, which draws from the Edwards Aquifer. All wastewater from FSH is treated by the City of San Antonio; no sewage treatment occurs at FSH. The ROI for utilities and infrastructure is FSH proper.

3.1.9.1 Electricity

Electrical power is provided by CPS to one substation and various services on post. Power to the substation is master-metered and then distributed to various facilities via lines owned by FSH. The installation's electricity consumption declined approximately 12 percent from approximately 190 million kilowatt hours (kWh) in 1996 to approximately 177 kWh in 1998 when the installation population was 17,632, for an average per capita use of approximately 10,000 kWh. The per capita usage reflects an approximate 17 percent decline from 1996 to 1998 (U.S. Army, 2000a). Energy use is highest in the summer months. In addition to the electrical power provided by CPS, FSH has several auxiliary generators to supply emergency power to BAMC, medical clinics, and the fire station (Cecilia, 1996).

3.1.9.2 Natural Gas

Natural gas is used for heating and cooking at FSH. As a result of utilities privatization of the natural gas supply system in September 1999, the CPS owns and maintains the gas distribution lines throughout FSH. Natural gas consumption for FSH in 1996 was approximately 492 million cubic feet (cf), and declined by 1998 to approximately 435 million cf (U.S. Army, 2000a).

3.1.9.3 Potable Water

FSH obtains all of its drinking water from the Edwards Aquifer, which supplies water to 17 cities and communities. The post owns and operates its own water production and distribution system consisting of five wells, two treatment plants, approximately 422,000 linear feet of distribution pipelines, and two approximately 1.0 million gallon elevated storage tanks. A six-phase project is underway to replace all of the old cast-iron distribution lines with new piping. Phases I through IV have been completed, and funding is being sought for the remaining phases (USAMC, 1999a).

The average annual FSH water usage from 1990 to 1999 was 3,479 acre-feet, or 1,126 million gallons (including irrigation and industrial use). FSH uses approximately 800 acre-feet of water for irrigation of golf courses, VA cemetery, and common areas, and in several cooling towers at BAMC. FSH recently partnered with the San Antonio Water System to use recycled water for these areas, which will help reduce FSH's dependency on the Edwards Aquifer. Table 3-19 lists the total and average annual water use at FSH from 1990 to 1999. FSH water usage has declined approximately 20 to 30 percent since 1996, largely due to the implementation of better water conservation programs at FSH.

Table 3-19 Total and Average Water Use at Fort Sam Houston

FY	Total Water Use	
	Thousand Gallons	Acre-feet
1990	1,442,677	4,457
1991	1,255,858	3,879
1992	1,243,365	3,841
1993	1,147,615	3,545
1994	1,148,015	3,546
1995	1,196,032	3,695
1996	1,169,565	3,613
1997	908,752	2,807
1998	951,061	2,938
1999	798,086	2,465
Average	**1,126,103**	**3,479**

Acre-feet: = millions of gallons X 3.0891

Source: FSH Public Works Business Center, 2000.

Water quality is regulated by the TNRCC. Water samples are tested monthly for bacteria and pH by the Preventive Medicine Department. The Environmental and Natural Resource Division at FSH tests the post water supply for lead and copper at

three-year intervals. Treatment of water by chlorination is handled by FSH personnel (Cibildak, 1996).

3.1.10 Transportation and Circulation – FSH

The ROI for transportation includes FSH and access roads to and from the post (see Figure 3-10).

3.1.10.1 On-Post Traffic

FSH is centrally located within the northeastern quadrant of San Antonio, which has one of the largest networks of city highways in the United States. Regional access to the post is provided by the Interstate Highway system, specifically, IH-35.

FSH is an open post with many access points. Major access routes onto the post are New Braunfels Avenue, Harry Wurzbach Road, Binz-Engleman Road, W.W. White Road, Cunningham Avenue/Wilson Street, and Walters Street/Scott Road. New Braunfels Avenue and Binz-Engleman Road are prone to heavy congestion during rush hours, as is the intersection at Binz-Engleman Road and Road S-33E (see Figure 3-10). The post operates an intra-installation transit system that complements San Antonio's public bus line to FSH. The City's public transit system is being reviewed to improve efficiency and ridership. At present, a bus ride from downtown San Antonio to FSH may take up to an hour, while the same trip in a private vehicle may take as little as 15 minutes (Garza, 1996).

Two traffic areas were prone to flooding when Salado Creek overflows its banks. Traffic flow was interrupted when the intersection of Binz-Engleman Road and Road S-33E was flooded. A new four-lane bridge was recently constructed where Binz-Engleman Road crosses Salado Creek, replacing a low-water two-lane bridge that was prone to flooding. Replacement and expansion of the bridge's capacity was required to accommodate traffic exiting the new BAMC and entering the post. A portion of W.W. White Road, where it crosses Salado Creek, remains subject to inundation in a flood as small as a 2-year frequency event (USACE, 1996). There are no immediate plans to correct this problem as funding is not available. However, the new Binz-Engleman Road bridge has significantly improved the BAMC traffic during high water periods (Carden, 2001).

3.1.10.2 BAMC Access

A $6.7 million contract was awarded by the Texas Department of Transportation on 4 October 1996 to widen IH-35 and to build an interchange for access to the new BAMC. The new interchange was necessary to allow vehicles (both emergency and personal vehicles) traveling directly to the BAMC to use an overpass, bypassing the two existing constrained intersections. This project, completed in 1998, facilitates easier and more direct access to BAMC for military personnel, civilians, and emergency vehicles.

3.1.11 Recreation – FSH

The ROI for recreational facilities and activities is the base itself.

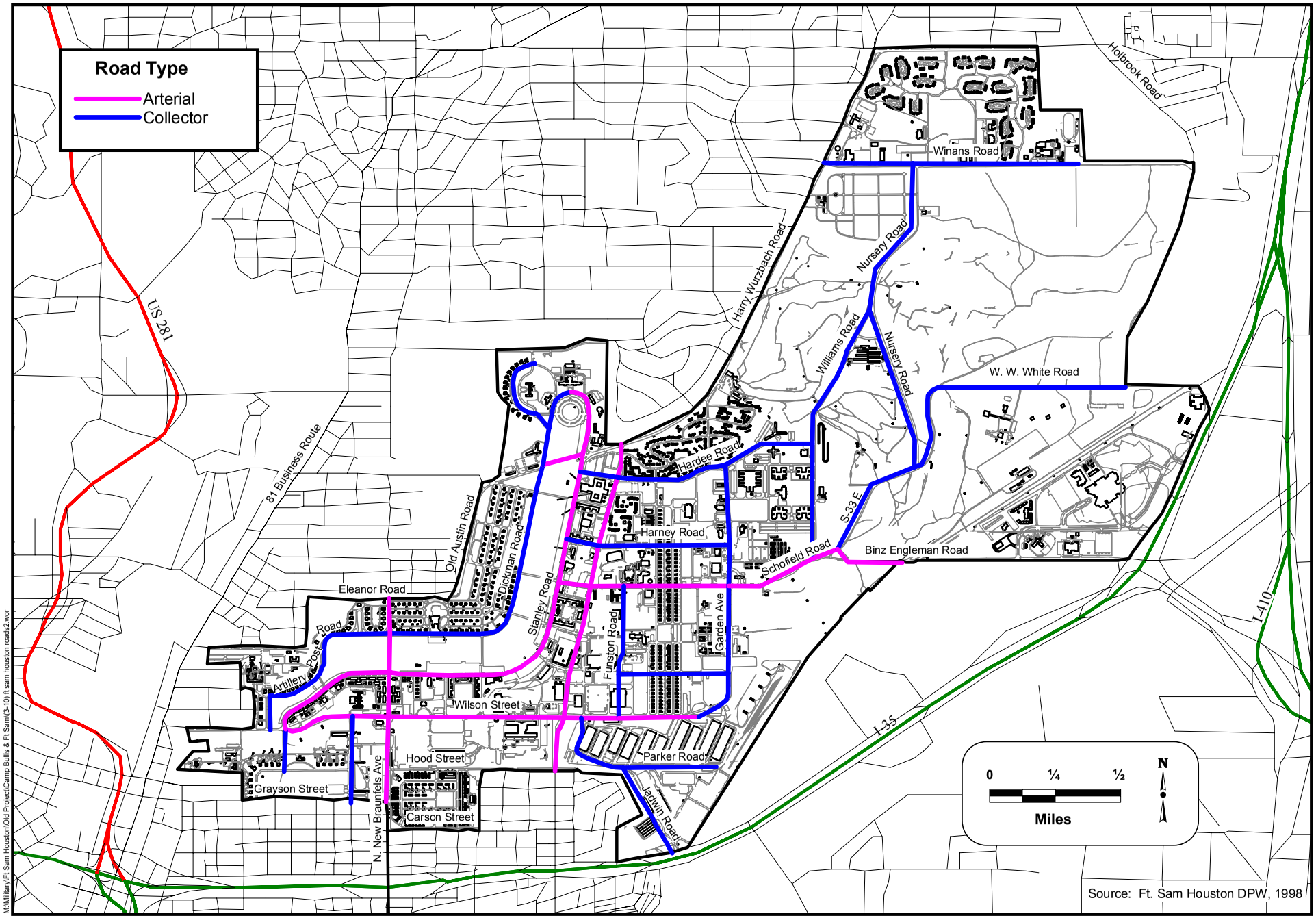


Figure 3-10 -- Fort Sam Houston Transportation Map

3.1.11.1 On-Post Recreation

FSH manages a wide array of facilities and organized programs that fulfill the needs of both military personnel and affiliated civilian employees. The purpose of these programs and facilities is to increase the morale as well as the mental and physical fitness of the users.

The Harlequin Dinner Theater provides year-round dramas, musicals, and comedies accompanied by a buffet-style dinner. The Hacienda Recreation Center serves between 14,000 and 16,000 personnel per week. It provides musical instruments, talent contests, and a snack bar. It is also the headquarters for the Better Opportunities for Single Soldiers (BOSS) Program. The Neon Recreation Center provides activities primarily for occupants of the BOQ. Movies, big screen televisions, and video games are among the items available. The Information, Travel, and Reservations (ITR) Center provides full service travel and recreation arrangements. The Center sells discounted tickets to major regional events and can procure hotel and flight reservations throughout the United States. A 27,300 square foot on-post library houses more than 55,000 books and 200 current periodicals in addition to a microfilm collection. Interlibrary loan and self-development and educational programs are also available. An auto crafts center provides 17 bays and stalls along with a complete inventory of loanable tools/equipment for auto repairs. A 24-lane bowling center with a child nursery is available on post.

FSH provides a wide variety of indoor and outdoor sports-related facilities. Two 18-hole golf courses are available that cover 496 acres, including a seven-acre driving range, practice greens, pro shop, and clubhouse. Brigade Gymnasium offers a basketball court, sauna, exercise equipment, and intramural programs. The Jimmy Brought Physical Fitness Center is a 68,000 square foot, $7.1 million facility that provides the majority of indoor recreational services on post. The main basketball court can seat 2,000 people, and there are three adjacent practice courts. An indoor pool, five racquetball courts, weight rooms, and saunas are also available.

Outdoor playing fields and courts include: seven softball fields, four baseball fields, three football fields, nine soccer fields, seven basketball courts, three paintball areas, and 10 tennis courts. The intramural sports program utilizes all the facilities at FSH. The Outdoor Recreation Center (ORC), located in Bldg 1111, is responsible for maintaining and renting equipment related to camping, boating, and other outdoor activities. A variety of boats can be rented, along with tents and air-conditioned campers. ORC maintains two travel camps in the eastern portion of FSH equipped with water and electrical hook-ups for 12 and 50 recreational vehicles, respectively. Riding stables and facilities at FSH provide a complete horsemanship program, including trail riding, youth and adult instruction, the stabling of privately owned horses, and rental of government-owned horses.

3.1.12 Hazardous Materials/Hazardous Waste and Solid Waste – FSH

This section addresses hazardous materials and hazardous and other waste management activities at FSH. The ROI for hazardous materials/hazardous waste and solid waste is FSH proper.

Hazardous materials and hazardous waste management activities at FSH are governed by specific environmental regulations. The State of Texas regulates hazardous and nonhazardous waste through the TNRCC under Title 30 of the Texas Administrative

Code, Chapter 335, Industrial Solid Waste and Municipal Hazardous Waste. The EPA has delegated to TNRCC the authority to implement the Resource Conservation and Recovery Act (RCRA) program.

Transportation of hazardous materials is regulated by the U.S. Department of Transportation (49 CFR §§ 100-199). The State of Texas regulates the transport of hazardous waste on public roads and right-of-ways (ROWs) under 30 Texas Administrative Code 335.

3.1.12.1 Hazardous Materials

Section 4.0 of AR 200-1, *Environmental Protection and Enhancement*, outlines Army policy for hazardous materials management and related pollution prevention. The Army and EPA encourage a reduction in the use of many of these hazardous and toxic materials due to their toxicity.

Activities and maintenance processes at FSH require the use of hazardous and toxic materials. The most commonly used hazardous materials include aviation and motor fuels, various grades of petroleum products, paints, solvents, thinners, adhesives, cleaners, batteries, acids, bases, refrigerants, compressed gases, and pesticides. The management and distribution to shops of hazardous materials at FSH is accomplished primarily through standard Readiness and Logistics Business Center (RLBC) supply channels based on forecasted and immediate needs. Special hazardous materials, including pesticides, medical supplies, and fuels, are maintained and distributed through alternate channels. In addition, approved individuals or organizations may obtain small quantities of hazardous materials from off-post sources with International Merchant Purchase Authorization Cards. The Public Works Business Center (PWBC) Environmental Division (ED) performs hazardous material reporting for compliance with the *Emergency Planning and Community Right-to-Know Act* (EPCRA) and other regulations.

Most hazardous materials at FSH are utilized in small to moderate quantities with limited spill potential. Some materials and chemicals, however, are stored in larger quantities depending on the needs for specific facilities. The FSH *Oil and Hazardous Substances Emergency Contingency Plan* (OHSCP) (USACE, 1998) addresses spills and spill control for hazardous materials. The plan identifies specific facilities that store hazardous materials in bulk or in potentially reportable quantities, including RCRA and non-RCRA hazardous wastes, and specifies appropriate control and countermeasures for the materials. In addition, the plan identifies key personnel, individual responsibilities, and facility-specific procedures to follow in the event of a hazardous substance spill.

Ordnance

There is no longer any large quantity storage of ordnance at FSH, because the former storage facility was determined to be located too close to a public right-of-way. Large quantity storage of ordnance has been relocated to Camp Stanley. However, Explosive Ordnance Disposal (EOD) and law enforcement personnel maintain small quantities of small arms ammunition and explosives at FSH, stored in protective bunkers that are separated from areas where other hazardous materials are stored (Mariah Associates, Inc., 1995). The northern part of FSH was used intermittently for various types of

gunnery practice during its early history. There is a potential for unexploded ordnance in some areas, particularly in the area of the National Cemetery (Geo-Marine, 1993).

Storage Tanks

Section 4.5 of AR 200-1, *Environmental Protection and Enhancement*, outlines Army storage tank management policy and incorporates Federal regulations. The PWBC manages storage tanks and storage tank releases at FSH in accordance with AR 200-1 and the FSH *OHSCP* (USACE, 1998a), which contains both a *Spill Prevention Control and Countermeasures Plan* (SPCCP) and *Installation Spill Contingency Plan* (ISCP). These plans provide prevention and control measures to minimize the potential for spills from storage tanks, and establish plans and procedures for controlling and mitigating sudden releases of petroleum products or hazardous materials.

Petroleum fuels and products, as well as waste POL products, are stored in various tanks throughout FSH. Materials stored include diesel fuel (DF-2), gasoline, kerosene, and waste oil. Table 3-20 summarizes information regarding underground storage tanks (USTs) at FSH.

Table 3-20 Summary Information for Underground Storage Tanks (USTs) at FSH

Tank ID	Bldg No.	Size (gal)	Contents	Use	Year Installed	Tank Material
8	155	550	DF-2	APU	Unknown	FRP
38	2610	10,000	DF-2	Fuel	1993	FRP
39	2610	10,000	Gasoline	Fuel	1993	FRP
40	2610	10,000	Gasoline	Fuel	1993	FRP
41	2610	10,000	Gasoline	Fuel	1993	FRP
46	2630	500	DF-2	APU	1980	FRP
47	2792	1,000	DF-2	APU	1976	FRP
none	3100	550	Oil	Fuel	Unknown	FRP
58	4050	10,000	DF-2	Fuel	1983	FRP
59	4050	10,000	Gasoline	Fuel	1983	FRP
60	4050	10,000	Gasoline	Fuel	1983	FRP
61	4050	10,000	JP-8	Fuel	1983	FRP

DF-2 = No. 2 diesel fuel
JP-8 = Jet propellant
APU = Auxiliary power unit
FRP = Fiberglass

Source: USACE, 1998a; DPW, 2001a.

Table 3-21 summarizes information regarding active aboveground storage tanks (ASTs) at FSH. Factors concerning secondary containment, preventive maintenance, security, and spill notification procedures are contained in the FSH *OHSCP* (USACE, 1998a).

Table 3-21 Summary Information for Aboveground Storage Tanks (ASTs) at FSH

Bldg No.	Size (gal)	Tank Status	Contents	Tank Material
16	250	Active	DF-2	Steel
16	250	Active	DF-2	Steel
155	50	Day tank	DF-2	Steel
2190	500	Active	DF-2	FRP
2190	500	Day tank	DF-2	Steel
2411	300	Active	Waste Oil	FRP
2610	500	Active	Waste Oil	FRP
2610	250	Active	Motor Oil	Steel
2630	50	Day tank	DF-2	Steel
2792	75	Day tank	DF-2	Steel
2912	1,000	Active	Gasoline	Steel
3100	500	Active	DF-2	Steel
3520	6,000	Active	JP-8	Steel
3520	600	Pod	JP-8	Steel
3520	600	Pod	JP-8	Steel
3605	10,000	Active	DF-2	Steel
3605	10,000	Active	DF-2	Steel
3605	10,000	Active	DF-2	Steel
3605	10,000	Active	DF-2	Steel
4209	300	Active	Waste Oil	FRP

DF-2 = No. 2 diesel fuel
JP-8 = Jet propellant
APU = Auxiliary power unit
FRP = Fiberglass

Source: USACE, 1998a.

Pesticides

Pest management at FSH is administered by the PWBC in accordance with the *Installation Pest Management Plan* (IPMP) for FSH (U.S. Army, 1998b). The IPMP incorporates Federal and state regulations, as well as DoD guidance/instructions, regarding the registration, use, and management of pesticides. The IPMP incorporates

considerations relative to environmental protection, including protection of the public, sensitive areas, and endangered and protected species; pesticide spills and spill response; and pollution prevention and control. The plan incorporates the integrated pest management (IPM) approach, or the use of multiple techniques to prevent or suppress pests in a given situation. IPM emphasizes nonchemical strategies for pest control whenever possible, including mechanical and physical control, cultural control, and biological control. Chemical control is considered to be a low-priority form of control.

Pesticides are currently stored in two primary locations at FSH: (1) in the PWBC pesticide storage facility at Building 4168, and (2) in three prefabricated storage facilities located adjacent to the Golf Course Maintenance Shop, Building 3100. The storage buildings at the Golf Course Maintenance Shop were designed in accordance with the requirements of Military Handbook 1028/8A for proper storage of pesticides. In addition to the two primary pesticide storage locations at FSH, the Self-Help Store and Post retail stores (e.g., AAFES PX) maintain small inventories of shelf-type pesticides for distribution and retail sale. The Veterinary Services Activity also maintains a small inventory of pesticides for the purpose of treating animal and pet-related pests, such as fleas and ticks, at the veterinary facility (U.S. Army, 2000a).

Chemical pesticide usage on FSH consists of the application of insecticides, herbicides, and rodenticides to control disease vectors and public health pests; quarantine pests; pests of real property; noxious, invasive plants and undesirable vegetation; ornamental plant and turf pests; animal pests; and household and nuisance pests. The Installation Pest Management Coordinator (IPMC) maintains records of chemical pesticide application. Pesticide usage is documented on a monthly Pest Management Report (DD Form 1532). All pesticide application is performed in accordance with the requirements of and under the supervision of a FIFRA (Federal Insecticide, Fungicide and Rodenticide Act)-certified or Texas-licensed pesticide applicator in accordance with the IPMP (U.S. Army, 1998b).

In FY 1999, FSH pesticide usage totaled approximately 1,008 pounds of active ingredients for the PWBC Pest Control Shop, Self-Help Program, and contracted service organizations. In FY 1999, pesticide usage by the FSH Golf Course totaled approximately 1,144 pounds. Table 3-22 summarizes the FY 1999 pesticide usage amounts for the Pest Control Shop, Self-Help Program, and contracted service organizations, and Table 3-23 provides usage for the FSH Golf Course.

3.1.12.2 Hazardous Waste Management

Section 5.0 of AR 200-1, *Environmental Protection and Enhancement*, outlines Army policy for hazardous waste management and waste-related pollution prevention. The EPA categorizes FSH as a large quantity hazardous waste generator, which means that the installation generates more than 1,000 kilograms (2,204 pounds) of hazardous wastes per month. Normal operations at FSH produce RCRA hazardous waste, as defined in 40 CFR §§ 261-265 and 30 Texas Administrative Code 335. Most hazardous waste is generated at FSH by processes associated with maintenance and medical activities. Current hazardous waste management activities at FSH are performed by a licensed contractor in concert with the Environmental and Natural Resources Office (ENRO).

Table 3-22 FY 1999 FSH Pesticide Usage Totals for the PWBC Pest Control Shop, Self-Help Program, and Contracted Service Organizations

Pesticide Name	FY 1999 Usage (pounds)	Pesticide Name	FY 1999 Usage (pounds)
Abamectin	0.63	Glyphosate	28.88
Acephate	37.67	Hydramethylnon	72.71
Baygon	24.81	Imazapyr	0.65
Bendiocarb	1.5	Lambda Cyhalothrin	0.29
Boric Acid	258.73	Malathion	2.27
Bromadioline	0.04	Mehtomyl	0.16
Bromacil	17.71	Permethrin	362.52
Carbaryl	20.6	Pyrethrum	29.04
Chlorpyrifos	17.36	Resmethrin	0.1
Cyfluthrin	0.7	Rotenone	43.19
Deltamethrin	0.12	Silica	0.31
Diazinon	67.54	Sulfuramid	>0.01
Dimethyl Phosphonate	1.62	Tetramethrin	1.74
Diuron	1.16	2,4-D	7.01
Fenoxycarb	1.22	Bacillus Thuringiensis	7.88

Source: (PWBC, 2001a).

Table 3-23 FY 1999 Pesticide Usage Totals for FSH Golf Course

Pesticide Name	FY 1999 Usage (pounds)	Pesticide Name	FY 1999 Usage (pounds)
Acephate	3.375	Mancozeb	31.2
Ammonium Chloride	.5	MSMA	29.34375
Azoxystrobin	3.5	Pendimethalin	516
Bensulide/Oxidiazon	349.93904	Prodiamine	185.25
Chlorpyrifos	7.9375	Trinexapac	.2112
Glyphosate	15.36	2,4-D	2.1375

Source: (PWBC, 2001a).

Hazardous wastes are handled, transported, and stored in accordance with the *Installation Hazardous Waste Management Plan* (U.S. Army, 1993a). The plan sets

forth procedures to achieve and maintain regulatory compliance regarding material management or administrative responsibilities, turn-in procedures, a hazardous materials inventory, training, a waste analysis plan, a tracking system, and hazardous waste storage, packaging, labeling, and shipment requirements. The *Hazardous Waste Management Plan* is being updated to include additional information concerning underground storage tanks (USTs), aboveground storage tanks (ASTs), and motor pool operations (Walker, 1996). In addition to this plan, the post has developed an *OHSCP*, which contains both an SPCCP and ISCP (USACE, 1998a). These plans provide prevention and control measures to minimize the potential for spills of hazardous and toxic chemicals, and establish plans and procedures for controlling and mitigating sudden releases of petroleum products and/or hazardous materials.

Hazardous wastes on FSH are accumulated at approximately 16 satellite accumulation points around the installation. Satellite accumulation points are locations, typically near the point of waste generation, where up to 55 gallons of a specific hazardous waste stream, or up to one quart of an acutely hazardous waste stream, may be accumulated (U.S. Army, 2000a). More than one waste stream may be accumulated and stored at a satellite accumulation point, but no more than one 55-gallon drum of a specific hazardous waste stream (or one quart for acutely hazardous waste) may be accumulated. Once accumulation volume limits are reached, and periodically, wastes are moved from BAMC to Building 4055, the less-than-90-day hazardous waste storage area (U.S. Army, 2000a). The hazardous wastes are collected from Building 4055 within the 90-day limit by an EPA-licensed transporter and delivered to an FSH-approved and appropriately licensed off-site disposal facility. The Defense Reutilization and Marketing Office (DRMO) contracts the off-site transport and disposal of hazardous waste from FSH.

Medical-related hazardous wastes (non-biohazards) are managed along with industrial hazardous wastes under the Installation Hazardous Waste Management Plan (U.S. Army, 1993a). Medical-related hazardous wastes at FSH are generated primarily through the BAMC and the AMEDDC&S. A large portion of these wastes consist of lab packs, which are consolidated containers of appropriately labeled and segregated, expired or off-specification, lab chemicals that are generated by various clinics and laboratories throughout FSH. Other medical-related wastes generated at FSH include waste photographic and x-ray materials, waste drugs, regulated biohazards and biological wastes, and low-level radioactive wastes (LLRW). Regulated medical waste and LLRW are discussed in Sections 3.1.12.3 and 3.1.12.4, respectively.

In FY 1999, FSH generated and disposed of 18 different hazardous waste streams totaling approximately 259,000 pounds (Green, 2001a). Table 3-24 summarizes FSH's FY 1999 hazardous waste streams. Demolition debris (classified as waste code D008) comprised approximately 88 percent (227,340 pounds) of the total hazardous waste generated in FY 1999. Photographic wastes (waste code D011) were the second largest waste stream in FY 1999, comprising approximately 4 percent (11,115 pounds) of the total. Waste solvents from degreasing operations (waste codes D001, D039, D018, and D004) and laboratory operations (waste codes D001, U002, F003, and F005) comprised nearly 4 percent (10,651 pounds) of the hazardous wastes generated in FY 1999. The remaining 4 percent of the FY 1999 hazardous waste streams consisted of medical- and laboratory-related wastes (lab packs, spent formalin, epinephrine, spent alcohol, and chemical masks), vehicular maintenance wastes (brake fluid, gasoline, and batteries), paints and filters, firing range filters, mercury, cleaning compounds, and absorbent material.

Table 3-24 Summary of FSH Hazardous Waste Streams for FY 1999

Waste Stream	Quantity (lbs)	Hazardous Waste Code
Paint	381	D001, F001, F005
Photo Fixer	11,115	D011
Spent Alcohol	722	D001, F001, F003
Gasoline	1,917	D001, D018
Lab Pack	4,347	U072, D018, D008, D035, D007
Batteries	100	D002, D008, D007
Demolish Debris	227,340	D008
Mercury	344	D009
Spent Solvent From Lab	1,773	D001, U002, F003, F005
Spent Formalin	730	D001, F005, F003
Filter with Lead From Firing Range	75	D008
Epinephrine	30	P042
Chemical Mask	30	D007
Solvent From Degreasing Operation	8,878	D001, D039, D018, D004
Cleaning Compound	386	D006, D008, D027, D039
Paint Filters	135	D007
Aqueous Brake Solution	285	D039
Absorbent Material	508	D018, D008, D039

Source: PWBC, 2001a.

3.1.12.3 Medical and Biohazardous Waste

Army organizations, and most states, apply the term Regulated Medical Waste (RMW) to what is sometimes known as infectious or biohazardous waste. Current Federal regulations do not address RMW, but do allow states to individually regulate RMW. The State of Texas addresses RMW under 30 Texas Administrative Code 330, *Municipal Solid Waste*, and 25 Texas Administrative Code, *Medical Waste*. The AMEDD has responsibility for properly managing and disposing of RMW. Health care facilities within the Army generally have their own regulations, which reflect state and local requirements. These regulations are reviewed and the actions described are monitored regularly through various AMEDD inspections.

In FY 1999, FSH disposed of approximately 114 tons of RMW. Disposal was performed at a private/municipal medical incinerator. The majority of the RMW at FSH is generated by the BAMC. Wastes include contaminated linens, surgical equipment, sharps (needles, etc.) and other medical items. All RMW generated is stored near the point of generation in containers with appropriate biohazard labels. Approximately two times per week, the waste is collected by a licensed contractor and transported off-post for

disposal or destruction as appropriate. All RMW is treated as manifested waste and tracked from "cradle to grave" (U.S. Army, 2000a).

3.1.12.4 Low-Level Radioactive Waste

Low-Level Radioactive Waste (LLRW) is defined as any radioactive material that has a half-life of 35 years or less, or fewer than 10 nanocuries per gram of transuranics. LLRW is produced by nuclear power plants, hospitals, certain industries, research institutions, and universities. LLRW includes: uranium, thorium, cesium, tritium, and other radioactive metals from industrial and medical processes; protective clothing used by workers; and machinery parts, tools, and other contaminated equipment.

LLRW at FSH can consist of a variety of items, including medical equipment, exit signs, smoke detectors, watches, and other equipment with radioactive components. FSH compartmentalizes the storage of LLRW through BAMC Radiation Safety. As military equipment containing low-level radioactive components is removed from service (e.g., during demolition), the equipment is manifested as waste and delivered to BAMC Radiation Safety, where it is stored in a designated containment area. Occasionally, small components, such as watches with tritium face enhancements, may be disassembled to store only the portion with the radioactive material. Based on the quantity in storage, BAMC Radiation Safety will contact a licensed contractor utilized by FSH to pick up the waste and dispose of it at a licensed, off-post disposal facility. LLRW removed from civilian facilities, such as smoke detectors removed from family housing, is disposed of directly in accordance with the Federal *Low-Level Radioactive Waste Policy Act (1980)* and Texas regulations (U.S. Army, 2000a).

3.1.12.5 Installation Restoration Program

The Installation Restoration Program (IRP) is the basis for response actions at military installations for sites contaminated with hazardous waste under the provisions of the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) and the *Superfund Amendments and Reauthorization Act* (SARA). The IRP sites at FSH are:

- FTSH (IRP Designation) 13 – Pershing Firing Range;
- FTSH 26 – landfills 6, 7, 8a, 8b, 10, and 12;
- FTSH 29 – landfill 4a; and
- FTSH 30 – landfill 4b, 2, 3, and 5.

3.1.12.6 Solid Waste Management and Recycling Program

FSH generates an average of approximately 800 tons of refuse per month. This includes refuse from base housing, BAMC, and all tenant organizations. A private, licensed hauler collects mixed refuse and transports it off-site to a private/municipal landfill. In FY 1999, 9,491 tons of solid waste was disposed of at an off-site landfill (Walker, D., 2000). This represents a decrease of approximately 9 percent from mid-1990 disposal rates. Current generation rates are not expected to change significantly in the future.

Source reduction is the use of materials, processes, or practices that reduce or eliminate the quantity and toxicity of wastes at the source of generation. Recycling refers to the reuse or regeneration of materials and wastes into usable products and byproducts. The

post currently recycles approximately 10 percent of the solid waste stream. In FY 1999, 803 tons of solid waste were recycled (PWBC, 2001a). Recyclables currently collected through the curbside recycling program (operated by Mission Disposal) include newspaper, aluminum, clear glass, plastic, and tin/steel. Additionally, PWBC maintains a base-wide program for recycling mixed paper and cardboard. In other efforts to limit solid waste disposal costs, the post has implemented a composting operation for yard wastes.

3.1.12.7 Wastewater

FSH owns the wastewater distribution system on base, which consists of approximately 262,000 linear feet of mains (USAMC, 1999a). Wastewater from the FSH distribution system is delivered via a single lift station into sewer mains owned and maintained by the City of San Antonio at 22 locations (USAMC, 1999a). All wastewater generated at FSH is treated off-site by the City of San Antonio; no sewage treatment occurs at FSH. The wastewater that enters the City of San Antonio mains is not metered. FSH is billed for sewer service for 59.5 percent of the volume of water that is pumped by FSH from the Edwards Aquifer. The remaining volume of water is used primarily for irrigation and does not enter the sewer system. The San Antonio Water System is responsible for quarterly monitoring that occurs at three of the discharge points (Cibildak, 1996). The San Antonio Water System also performs inspections every six months to estimate the volume of water that is being discharged from FSH (Oliva, 1996).

FSH has an industrial wastewater discharge permit, issued by the Wastewater Quality Division of the San Antonio Water System in June 1995, which sets limits on pollutants. In early 1996, a violation for zinc levels of 2.54 mg/L was attributed to the ionization of long-standing softened water in the new BAMC piping system during the several years of construction of the complex.

3.2 CANYON LAKE RECREATION AREA

3.2.1 Earth Resources – CLRA

Earth resources discussed in this section include geology, soils, and topographic features associated with the CLRA. The ROI for earth resources comprises the areas within the physical boundaries of the FSH CLRA lease area.

3.2.1.1 Geology

The CLRA is underlain by the Upper members of the Glen Rose Limestone Formation (approximately 400 feet thick). This formation consists of beds of moderately resistant, massive chalky limestone alternating with beds of less resistant, marly limestone. The erosional differences in these two beds have formed a terrace-type topography in the area that resembles balconies facing the southeast; hence, the Spanish name "Balcones." The upper and lower members of the Glen Rose Limestone Formation are divided by a zone of oyster-like fossils, *Salenia texana* (U.S. Army, 1991a). The lower member of the Formation, consisting of about 200 feet of alternating limestones, marls, and shales, overlies about 100 feet of massive fossiliferous limestone. The lower members underlie the major portion of the Canyon Lake reservoir.

Overlying the Glen Rose Limestone Formation is the lowest member of the Fredericksburg Group, the Walnut Clay. This formation is, in turn, overlain by the Comanche Peak Limestone Formation. Where mapped, these two formations are

generally depicted as a single unit due to the difficulty of determining the change between them (U.S. Army, 1991a).

Overlying the Comanche Peak Limestone Formation is the Edwards Limestone Formation. The lower part of the Edwards Formation and the upper part of the Comanche Peak Formation are very similar. The Comanche Peak Formation, the Edwards Formation, and the overlying Georgetown Formation are generally mapped as the Edwards and Associated Limestones. The Edwards Formation consists of gray to white, dense, hard, semicrystalline limestone, calcium limestone, and magnesium limestone (dolomite). In addition to common limestone and dolomite, marl (a limey clay rock), evaporites (common salt, gypsum, etc.), and chert (flint) are found in the Edwards Limestone. Chert is the identifying feature of the formation because it is not found in the other Cretaceous units. The Edwards Formation has been extensively fractured in the Balcones Fault Zone, a condition that admits large quantities of surface water. Surface water dissolves the limestone at a relatively rapid rate, forming cavities in the stone. This results in a highly cavernous and extensively honeycombed formation. The fossil beds of the formation appear more porous or susceptible to solution (U.S. Army, 1991a).

3.2.1.2 Soils

The soils found at the CLRA have not been mapped in as much detail as those of FSH; however, two major soil associations are identified within the Canyon Lake region. One of these is the Brackett-Tarrant-Denton Association, which comprises most of the upland Canyon Lake area. This association consists of very shallow to moderately deep, well-drained, gently sloping and hilly clay and clay-loam soils. These soils are primarily used for rangeland and are either moderately or severely limited for other use by shallow depth, rocks, slow permeability, high shrink-swell potential, and slope. The relative amounts of each of the individual soils series within this association are not known (U.S. Army, 1991a). The other major soil type is the Eddy-Houston Black-Stephan Association, which is found on the upland area in and around the Guadalupe Valley. It consists of deep, shallow and very shallow, moderately drained and well-drained, gently sloping, clayey soils. These soils are used mainly for cropland and pasture. Limitation for other uses is related to slow permeability, very high shrink-swell potential, and shallow depth in some areas (USACE, 1996).

Because the CLRA has minimal slope, soil erosion is not a major problem. However, some areas near the lake shore are beginning to show signs of erosion, primarily due to pedestrian traffic and erosion of the beach. As undergrowth is removed and development increases, erosion could induce additional degradation of the area (USACE, 1996).

3.2.1.3 Area Physiography/Topographic Features

The CLRA lies within the Edwards Plateau physiographic province of Texas, a geographically young plateau with a mature margin of moderate to strong relief, locally known as the “hill country.” Canyon Lake receives runoff from the Guadalupe River watershed, which has a drainage area of 1,425 square miles above the dam site. The watershed falls to the east-southeast with an elevation of 1,350 feet in the headwaters near Kerville to 750 feet at the dam site. The stream gradient within the project area is 6 feet per mile. The main divide of the watershed is 200 to 300 feet higher than the banks of the river, characterized by steep-walled canyons and generally rugged topography (USACE, 1991).

3.2.2 Air Quality – CLRA

Air quality at a given location is a function of several factors, as discussed in Section 3.1.2. The ROI for air quality is the area immediately surrounding the CLRA (Bexar, Blanco, Hays, Kendall, and Guadalupe Counties).

The CLRA is located in the same air quality control region (the Metropolitan San Antonio Intrastate AQCR 217) as FSH. In the mid-1980s, some particulate monitoring was done; however, it was discontinued as particulate levels recorded were consistently low. Currently, no additional air quality monitoring occurs at or near the CLRA.

3.2.2.1 Climate

Due to the proximity of the CLRA to FSH, general climatological conditions between the two areas do not vary. Refer to Section 3.1.2 for a description of regional climate.

3.2.2.2 Current Attainment Status

Volatile fuel storage at the CLRA includes one 500-gallon AST and one 1,000-gallon AST; however, both tanks are prefabricated, vaulted tanks that provide secondary containment of VOCs.

No incinerators are operated at the CLRA. Except for outdoor camping activities, no open burning occurs at the CLRA.

3.2.3 Noise – CLRA

The ROI for noise consists of the FSH CLRA lease area and adjacent lake areas.

3.2.3.1 Current Noise Environment

Sources for environmental noise at the CLRA are primarily associated with the recreational usage of the CLRA, specifically from outboard motors. Occasional helicopter flights in the area are also a noise source.

3.2.4 Water Resources – CLRA

This section briefly summarizes water resources, including surface water, groundwater, and floodplains and waterways in the vicinity of the CLRA. The ROI for water resources includes the area encompassed by the CLRA.

3.2.4.1 Surface Water

The CLRA is located on a ridge bounded on three sides by Canyon Lake reservoir. The reservoir covers 8,240 acres with a shoreline length of 80 miles at normal conservation pool level (909 feet above msl). It has a storage capacity of 740,900 acre-feet below the uncontrolled spillway, including 346,400 acre-feet of flood control storage and 28,100 acre-feet of sediment reserve. The lake has a maximum length of about 15 miles and a maximum width of about 4 miles, and controls runoff from 1,425 square miles of drainage area from the Guadalupe River watershed. Canyon Lake reservoir is a deep storage, bottom draining reservoir with a mean depth of 46 feet. Due to the depth of the lake, thermal stratification develops annually in the reservoir (USACE, 1991). Canyon Lake reservoir is used primarily for flood control and as a recreational area and also serves as a public drinking water supply.

The Guadalupe River is a spring-fed river that flows over limestone geology, which decreases the turbidity of the water entering the reservoir. However, flash flooding in the watershed often causes high inflows of turbidity. Canyon Lake has little industrial or urban development upstream from the reservoir, and inflows of highly polluted waters do not occur. Some polluted waters, however, may enter the lake as runoff from agricultural lands that may have been exposed to over-application of pesticides and/or fertilizers (USACE, 1996).

Low-flow and intermittent creeks also supply some water to Canyon Lake. These small sources of water include Jacob's Creek, Sorrell Creek, Potter's Creek, and Tom's Creek. These creeks usually have little impact on lake levels or water quality in the reservoir (USACE, 1991).

Canyon Lake is classified as "Water Quality Limited Use" because it is a public water supply reservoir. Designated uses include contact recreation, exceptional quality aquatic habitat, and aquifer protection. No water quality problems have been identified at the CLRA (USACE, 1996).

3.2.4.2 Floodplains and Waterways

The CLRA is located on a ridge bounded on three sides by Canyon Lake. All structures have been built above 960 feet msl, while the Canyon Lake Dam crest is at 943 feet msl (U.S. Army, 1991a). Area flooding has not been encountered at the CLRA recently; however, in 1987 some major flooding caused large-scale tree death along the entire reservoir shoreline (USACE, 1996). The marina is a floating structure that changes elevation as lake volumes fluctuate.

3.2.4.3 Groundwater

The CLRA does not rely on the Edwards Aquifer for its drinking water; however, it is within the area that drains into the Edwards Aquifer recharge area. Instead, the CLRA obtains water from a well drilled approximately 360.9 feet (110 meters) into the Glen Rose formation. An annual average of 3.7 million gallons of water are pumped from the well to a chlorination unit and then to a storage tank (USACE, 1996; U.S. Army, 1996c).

3.2.5 Biological Resources – CLRA

The ROI includes the CLRA.

3.2.5.1 Flora

Vegetation types at the CLRA are slope-dependent. Dense stands of live oak and ash juniper (*Juniperus ashei*) occur on the steeper slopes, while tree stands are less dense on the relatively flat upland areas, allowing some grassland to develop. Sections of the recreation area used by the public have been cleared of shrubs and low trees.

3.2.5.2 Fauna

Small to medium-sized fauna can be found at the CLRA, including armadillos, skunks, raccoons *(Procyon lotor),* opossums, fox squirrels, cottontail rabbits, and small rodents. The presence of numerous smaller mammals encourages predators such as coyote *(Canis latrans)* and bobcat *(Lynx rufus).* Since the peninsula is surrounded by water and roadways and is subject to nearly continuous human use, the terrestrial fauna have been somewhat isolated from the area.

3.2.5.3 Threatened and Endangered Species

No threatened or endangered species are known to inhabit the CLRA, nor is there sufficient unique habitat that might support such species (Appendix C). Most of the suitable unique habitat that may support federally listed threatened or endangered animal and plant species has been removed. The CLRA is, however, within the range of several species designated by the USFWS as threatened or endangered, including the golden-cheeked warbler, black-capped vireo, whooping crane, southern bald eagle, American peregrine falcon, arctic peregrine falcon, ocelot, widemouth blindcat, toothless blindcat, and the Comal blind salamander (see Table 3-7).

Karst features in the area have not been extensively investigated; therefore, conclusive information on karst-dependent arthropods is not available at this time. However, the existence of all karst-dependent species in the San Antonio area is threatened by the destruction and contamination of their habitat by urbanization (Veni, 1996).

3.2.6 Land Use and Visual Resources – CLRA

The ROI pertaining to the CLRA is the recreation lease area.

3.2.6.1 Land Use

The CLRA lease area is 110 acres and is located approximately 48 miles northeast of FSH, between IH-35 and US-281. Canyon Lake was originally constructed as a flood control and conservation project, but additional development in the area has provided recreation for both military and civilian area residents. The CLRA is owned and managed by the U.S. Army Corps of Engineers (USACE), and FSH holds a 50-year permit, issued by the USACE in 1965, to use the 110-acre recreational area for the benefit of area military personnel.

As a permittee, FSH is responsible for maintaining its facilities and complying with any state or Federal regulations governing water quality or hazardous substances (Povanka, 1999). However, the USACE is responsible for the overall management of Canyon Lake Reservoir and its primary function as a flood control facility.

The main access road for the CLRA is Jacobs Creek Road, which runs southwest to northeast and forms the southern boundary of the facility. The majority of development is clustered along a ridge line in the western portion of the site. The majority of the camping facilities used by both trailer campers and tent campers are located within a circular drive that allows access to the entire ridge area. A picnic area is located in the northeast portion of the ridge. To the east of the picnic area is a small inlet where water-dependent recreation activities and facilities are located, including a landing dock, marina, breakwater, beaches, and swimming area. A sewage treatment plant is located

on the west side of the ridge and is accessed by a small circular drive. An area just east of the camping area and northeast of the water plant has been cleared to provide helicopter access to the facility. A water plant is located just below the heliport area (see Figure 1-3).

The land surrounding the CLRA is owned by the USACE, and because lakeshore land is controlled by the USACE, only intermittent pockets of recreational and flood management facilities interrupt the natural shoreline. The property to the south of the CLRA is leased by the Air Force and also provides picnic and camping areas for military personnel. The area beyond the USACE property is mostly rural, undeveloped land. Higher density vacation communities, both old and new, are interspersed in the undulating landscape of the surrounding Texas "hill country" (U.S. Army, 2000a).

3.2.7 Socioeconomics – CLRA

The socioeconomic variable of interest to the CLRA is primarily the population that uses the facilities. The ROI relevant to the CLRA is the general San Antonio area within which the military personnel associated with FSH (and other military installations in the area) reside.

3.2.7.1 Annual Usage

The CLRA is used primarily in the summer months, particularly on the weekends and holidays. During these times, trailer occupancy rates have been as high as 95 to 100 percent. The average trailer occupancy rate during the peak summer period ranged from 72 to 79 percent over the last 5 years, while the annual average trailer occupancy rate was between 46 and 48 percent. It should be noted that trailer occupancy represents approximately 27 percent of the total recreation area usage. Rental and private boats represent approximately 14 percent of the CLRA use, recreational vehicles are 8 percent, tents are 3 percent, beach use is 12 percent, picnicking is 33 percent, and information is 3 percent (USACE, 1996). Utilization of the CLRA for FY 1996 was lower than usual in part due to reduced water levels in the lake and school starting earlier than in previous years. The current staff at the CLRA is 14.

Table 3-25 represents the FY 1996 totals for annual permits, entry fees, boat usage, and trailer usage at the CLRA.

Table 3-25 Fiscal Year 1996 Totals for CLRA Usage

Use Type	Total Numbers
Annual Permits	18,542
Entry Fees	13,345
Boat Usage	42,224
Trailer Usage	37,721

Source: Chambers, 1996.

3.2.8 Cultural Resources – CLRA

The ROI for cultural resources is the FSH lease area of the CLRA. The cultural resources management programs described in Section 3.1.8 apply and are implemented at the CLRA.

3.2.8.1 Prehistoric and Historic Archaeological Resources

In 1949, prior to impoundment of Canyon Lake, archaeological surveys were performed in the proposed lake area. Twenty sites were examined and three were recommended for further study. Recovered artifacts revealed intermittent occupation attributed to the Archaic Edwards Plateau Aspect and, to a lesser extent, the Central Texas Aspect. No important paleontological assemblages are known to be in the CLRA area (USACE, 1996).

3.2.8.2 Architectural Resources

No sites of NRHP significance are known to exist in the entire Canyon Lake area. However, the area may have been part of one of the small German farms believed to have been in operation in the mid-1850s. Some rock fences left by the German farmers still stand near Canyon Lake, but they are not in the FSH lease area (USACE, 1996).

3.2.9 Utilities/Infrastructure – CLRA

The ROI for utilities and infrastructure at the CLRA is the recreation lease area.

3.2.9.1 Electricity

Electrical power is supplied by Pedernales Electric Cooperative, Inc.

3.2.9.2 Propane Gas

A commercial distributor supplies propane for three storage tanks used to heat the small store, administration building, and 32 permanently sited rental trailers (mobile homes) available at the CLRA.

3.2.9.3 Potable Water

Potable water is obtained from an on-site 361-foot well that penetrates the Glen Rose formation. An annual average of 3.7 million gallons is pumped from the well to a chlorination unit and then to a storage tank (USACE, 1996; U.S. Army, 1996c). Water quality is regulated by the TNRCC. Monthly water samples are tested for bacteria and pH by the Preventive Medicine Department. The water is tested annually for copper and lead (Cibildak, 1996).

3.2.10 Transportation and Circulation – CLRA

The ROI for transportation and circulation is the CLRA lease area. Visitors to the CLRA have access to the area on paved roads.

3.2.10.1 Traffic Control – CLRA

Traffic at the CLRA is heaviest on weekends, but traffic congestion is not a problem.

3.2.11 Recreation – CLRA

The ROI is the CLRA lease area and the lake surface.

3.2.11.1 Recreation Uses – CLRA

A wide variety of water-related recreational equipment and facilities are available at the CLRA. The area provides 31 water and electric hook-ups for camp sites and permanent lodging lots for 32 three-bedroom mobile homes. A comfort station, small grocery store, and several other recreation and storage-related buildings are on-site.

A man-made beach, picnic area, party pavilion, screen shelters, and children's playground are some of the additional man-made recreational facilities. Boating, fishing, swimming, and water skiing are the main water activities available. Pleasure boats and jet skis can be rented at the CLRA.

3.2.12 Hazardous Materials/Hazardous Waste and Solid Waste – CLRA

This section addresses hazardous materials and hazardous and other waste management activities at the CLRA. The ROI for hazardous materials/hazardous waste and solid waste is the CLRA lease area. Hazardous material usage and hazardous and other wastes currently generated at the CLRA are minimal.

3.2.12.1 Hazardous Materials – CLRA

Hazardous materials use at the CLRA is minimal and is managed by FSH in accordance with Army policy and pertinent regulations. Such use consists primarily of fuels, gaseous chlorine, propane, and small quantities of POL products. Petroleum fuel storage at the CLRA includes gasoline stored in two above-ground storage tanks (a 500-gallon AST and a 1,000-gallon AST) near the marina. Chlorine gas is stored as compressed gas in cylinders at the water plant and waste-water treatment plant (WWTP) and is used to disinfect treated water and wastewater. Propane gas, stored in three above-ground propane tanks, is used to heat the grocery store and trailers at the CLRA. Additionally, small quantities of other POL-related products (e.g., cans of oil and grease) are stored and used at the marina area for minor maintenance of marine craft.

The FSH PWBC performs pest management at the CLRA in accordance with the FSH IPMP. No pesticides are permanently stored at the CLRA (U.S. Army, 2000a).

3.2.12.2 Hazardous Waste Management – CLRA

Currently, no hazardous waste streams are regularly generated at the CLRA. Potential spills of POL products associated with daily operations and recreational watercraft operations at the CLRA are covered by the CLRA *OHSCP*, which contains an SCCP and ISCP specifically for the CLRA. Any spill-related waste is temporarily accumulated in the area of the spill and is immediately transferred to FSH for storage until a licensed contractor can collect it for disposal (USACE, 1998b).

3.2.12.3 Medical and Biohazardous Waste

The CLRA is a recreational site. No RMW is generated or stored at the CLRA.

3.2.12.4 Low Level Radioactive Waste – CLRA

The CLRA is a recreational site. No LLRW is generated or stored at the CLRA.

3.2.12.5 Installation Restoration Program – CLRA

There are no identified IRP sites at the CLRA.

3.2.12.6 Solid Waste Management – CLRA

Solid waste from the CLRA is collected by a private, licensed hauler and transported off-site to a private/municipal landfill.

3.2.12.7 Wastewater

The CLRA WWTP is a packaged extended aeration and activated sludge system with a design capacity of 12,500 gallons per day (gpd). The wastewater collection system is a gravity flow system consisting of approximately 5,000 linear feet of mains (USAMC, 1999b). Treated effluent is discharged directly into Canyon Lake. The plant operates under a permit issued and administered by the TNRCC. In FY 1998, the plant treated approximately 1.3 million gallons of wastewater (USAMC, 1999b).

Since FY 1996, the volume of wastewater treated at the CLRA WWTP has decreased approximately 62 percent; however, this apparent reduction in wastewater volume is attributed primarily to the replacement of a faulty meter during FY 1997 that has resulted in a more accurate measurement of wastewater flow through the plant. Prior to the meter's replacement, the CLRA had on occasion apparently exceeded the permitted daily treatment volume of 12,500 gpd.

4.0 ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES

4.1 FORT SAM HOUSTON

4.1.1 Earth Resources – FSH

Neither considered alternative would have a significant or adverse impact on the geology, soils, or topographic features of FSH. A discussion of short-term impacts associated with construction or demolition activities at FSH is contained in the FSH PEIS (U.S. Army, 2000a).

4.1.2 Air Quality – FSH

The EPA has published rules on general conformity (40 CFR Parts 51, et seq.) that apply to Federal actions in any areas designated nonattainment for any of the criteria pollutants under the CAA. Because these rules apply only to nonattainment areas, they are not currently relevant to FSH or the CLRA, which are in attainment for all NAAQS, although this classification could change in the near future. The operation of FSH, as anticipated in both alternatives reviewed, is not expected to cause any change in the current attainment status for the installation or the San Antonio area. Any classification change would be based on the new 8-hour federal standard for ozone, which was recently upheld by the U.S. Supreme Court. Increased emission levels associated with construction projects on-post would be deemed temporary and minimal. However, if the new, stricter standards are implemented, EPA and Texas would have to confer and establish reduction goals within a set time frame to attain compliance with the new standards. FSH would then be required to comply with the revised requirements.

4.1.2.1 Alternative 1

The continuation of the existing mission at FSH (status quo) should not have a significant adverse impact on air quality on FSH or in the San Antonio area. FSH has not encountered any significant regulatory problems concerning air pollution. However, numerous actions are taken to minimize air pollution on-post. Automobile traffic is one of the largest contributors to air pollutants at FSH. Congestion during rush hour is the main source of the problem (U.S. Army, 1991a). Continued efforts to improve traffic circulation are recognized as one method to reduce this pollution. In addition, General Services Administration vehicles are regularly serviced to improve fuel efficiency and control emissions (U.S. Army, 1991a; Mariah Associates, Inc., 1995).

The combined effects of the approximately 4,000 boilers and space heaters on the post also contribute to cumulative pollutant emissions. Over the past 15 years, however, the associated pollution has decreased as a result of some conversion from fuel oil to natural gas, which burns more cleanly. The discontinuation of on-site incinerators has improved air quality. The woodworking facilities at FSH, which generate dust and particulate emissions, are equipped with particulate removal equipment such as vacuum filters and cyclone separators. When functioning, these improve air quality. VOC emissions are primarily due to degreasing operations and landfill emissions. Changes in degreasing operations or degreasing fluids could significantly reduce VOC emissions for FSH.

None of the current or proposed activities or operations at FSH is expected to have an impact on the climate of the region.

4.1.2.2 Alternative 2

Impacts on air quality associated with this alternative are similar to those associated with alternative 1. The estimated 2,400-person increase in population at FSH under Alternative 2 would result in additional traffic, but this increase would represent an extremely small percentage of the region's total traffic. While traffic is one of the largest contributors to air pollutants in the San Antonio area, a large percentage of the added base personnel are expected to come from within the San Antonio area. In summary, no measurable impacts to air quality are expected to result from the implementation of Alternative 2.

4.1.3 Noise – FSH

Neither alternative would have a significant or adverse noise impact at FSH. The most significant noise sources at FSH are traffic and occasional helicopter operations normally associated with the BAMC. No proposed activities at FSH under either Alternative 1 or Alternative 2 would significantly change the existing noise levels associated with these operations at FSH.

The small number of noise complaints logged in the recent past at FSH are not expected to increase because few activities around the post generate significant noise levels. One such activity is the helicopter flights to and from the medical facilities, but their economic and emergency medical benefits generally are perceived to outweigh any noise discomfort. A formal procedure, however, is in place for logging and responding to noise complaints. The Public Affairs Officer (PAO), the primary point of contact for any individual and/or organization wishing to file a complaint, is responsible for further investigating such complaints and recommending any necessary mitigative measures.

4.1.4 Water Resources – FSH

4.1.4.1 Alternative 1

Surface Water

Alternative 1, the status quo, would have no significant adverse effects on surface water. FSH does not use surface water as a potable water supply, and normal operations at the installation do not impact area water supply through surface water contamination. Furthermore, FSH does not directly discharge wastewater into Salado Creek. The normal storage and usage of hazardous materials complies with established contingency, spill, and pollution prevention plans, and there is a low probability of a release of contaminants that would reach surface waters at FSH.

Construction and demolition activities planned under this alternative are discussed and analyzed in detail in the FSH PEIS (U.S. Army, 2000a). As that document explains, the potential impacts upon surface waters associated with construction and demolition activities could alter soil profiles and natural drainage, which, in turn, could alter water flow patterns and loadings to Salado Creek. It is assumed that, during new construction, previously pervious surfaces would be covered with impervious cover such as asphalt, concrete, or buildings, with total coverage generally averaging about 1.5 times the building "footprint." It is also assumed that, when facilities are demolished, about 75 percent of the impervious surfaces, including paved areas, are restored to pervious surfaces.

The impacts analysis, as contained in the FSH PEIS, concerning planned construction and demolition under Alternative 1, indicates that FSH will experience an approximate net increase in impervious cover of 425,000 sf. This represents an increase of less than 1 percent over the current impervious area at FSH. This should not significantly increase runoff to Salado Creek.

In addition to affecting impervious cover, construction and demolition activities could affect the quality of current storm water runoff to Salado Creek. The description of soil types at FSH from Section 3.1.1.3 indicates that a majority of the installation is composed of soils that are susceptible to severe or moderate erosion, which could degrade surface waters. Construction or demolition activities can expose soils, thereby increasing sediment runoff and loading. In accordance with the FSH SWPPP and the *Erosion Control Master Plan*, best management practices including techniques such as berm construction, sediment traps, silt fences, and wind brakes would be implemented to minimize any runoff and subsequent degradation of water quality in Salado Creek. In addition, the EPA's NPDES program requires that any construction activity disturbing a contiguous area of greater than 5 acres is required to file an NOI under the EPA-administered Construction General Permit and demonstrate adequate control of runoff and erosion at the site. The EPA recently amended this program to include similar requirements for sites smaller than 5 acres. If accepted best management practices are applied in accordance with FSH plans and applicable Federal and state storm water regulations, water quality in Salado Creek is not anticipated to be adversely impacted by the forecasted construction and demolition activities under Alternative 1.

Groundwater

Area military installations have withdrawn a historical average of 4 million gallons of water per day from the Edwards Aquifer.

Under Alternative 1, FSH would continue to follow the FSH Water Use Reduction Program. These programs identify the need for a comprehensive water use and conservation plan and describe aquifer levels, spring flows, and associated management stages. On 5 November 1999, the USFWS issued Biological Opinion 2-15-98-R-759 (USFWS, 1999; Appendix B), which considered the effects of Edwards Aquifer withdrawals due to military activities. Any new water requirements associated with Alternative 1 (or Alternative 2) are to be offset by a corresponding decrease in water use by other military activities, resulting in no increase in the military's overall withdrawal of Edwards Aquifer water (USFWS, 1999). Additionally, the Opinion describes new DoD drought management plans based upon water levels in well J-17 and the volume of spring flows from Comal and San Marcos Springs (see Section 3.1.4.3). The purpose of these staged reductions during drought conditions is to increase the probabilities of survival for eight threatened or endangered species that depend on minimal flows from the aquifer. The USFWS concluded that, by utilizing these plans, ongoing and proposed military activities are not likely to jeopardize the continued existence of these species or to adversely modify designated critical habitat.

In March 1999, the San Antonio Military Water Working Group allocated newly established USFWS water usage caps for the years 2000-01 and 2002-03 to the four participating military installations. FSH was allocated 29.51 percent of the caps or 1,159,604 kgal per year for calendar years 2000 and 2001. The water cap for calendar years 2002-03 is reduced and equals 1,030,704 kgal per year (U.S. Army, 2000a).

FSH water use averaged 1,126,104 kgal per year from 1990 to 1999. The average per capita usage, assuming the 1999 installation authorized strength of 18,378 personnel, is 61 kgal per year. This figure does not include an expected smaller average per capita usage because 65 percent of the FSH population (day workers) would only be on the installation 33 percent of the time (U.S. Army, 2000a). Therefore, less than the 61 kgal per year per capita water demand volume is likely. However, for this analysis, the larger figure will be used to ensure a conservative computation.

Under Alternative 1, the authorized peacetime strength at FSH (see Table 2-2) is projected to decrease by approximately 640 personnel from 18,378 in FY 1999 to 17,738 in FY 2005. Based on this personnel reduction, the estimated 1999 per capita rate of 61 kgal per year, if constant through 2005, would produce a water demand of 1,082,018 kgal per year by FY 2005 (61 kgals x 17,738 personnel). This would reduce water demand by 39,040 kgal per year. As noted above, the most conservative water usage cap available for this analysis is 1,030,704 kgal, the year 2002-03 cap established by the San Antonio Military Water Working Group. Subtracting this cap from the projected water demand for 2005 yields a 51,314 kgal excess demand on the Edwards Aquifer.

However, the FSH Water Reuse Plan (using reused water for cooling towers and irrigation on FSH) is expected to reduce water demand from the Edwards Aquifer by 281,688 kgal per year (Schlatter, 2000). Therefore, comparing the projected base population figures for FY 2005 to the lowest available water usage cap for 2002-03 (1,030,704 kgal), FSH's expected water demand would be 800,330 kgal per year (1,082,018 kgal – 281,688 kgal). This figure is 230,374 kgal per year lower than the 2002-03 authorized water cap and therefore does not amount to a negative impact on the Edwards Aquifer (see Table 4-1).

Table 4-1 Edwards Aquifer Groundwater Caps and Demand Projections

	FY 2005 Projected Water Demand[1]	Water Demand Reduction Due to Reuse Water Plan	2002-2003 FSH Water Cap Allotment[2]	FY 2005 Final Projected Water Demand[3]
Alternative 1	1,082,018 kgal	281,688 kgal	1,030,704 kgal	800,330 kgal
Alternative 2	1,268,434 kgal	281,688 kgal	1,030,704 kgal	986,746 kgal

Source: U.S. Army, 2000a; Schlatter, 2000

[1] Based on estimated maximum FSH base population in 2005
[2] Smallest water cap established by the San Antonio Military Water Working Group
[3] Under either alternative, FSH will reduce water demand below authorized water draw from the Edwards Aquifer

Floodplains, Waterways, and Wetlands

No adverse impacts to floodplains, waterways, or wetlands are associated with Alternative 1. Flooding can be mitigated through drainage improvements, but some type of head-water retention is required to avoid flooding on the installation and downstream. Replacing the low-water bridge crossing of Salado Creek at Binz-Engleman Road with a four-lane bridge has improved BAMC access, but this will not induce development in the

undeveloped areas of the floodplain (USACE, 1994). Any outgrant that would affect the Salado Creek floodplain and its wetlands would be the subject of separate NEPA documentation.

4.1.4.2 Alternative 2

Surface Water

Impacts to surface water resources under this alternative would be similar to those described for Alternative 1. The potential for decreased demolition as a result of increased leasing or reuse of candidate facilities means that the net impervious cover (and subsequent storm water runoff) is likely to be larger than that described for Alternative 1. However, any such net increase would still be insignificant compared with the current impervious cover at FSH and is not anticipated to adversely affect conditions in Salado Creek. Construction and demolition activities would continue to be managed in accordance with applicable plans and storm water permitting requirements (U.S. Army, 2000a).

Alternative 2 is considered to present a greater potential for contamination of runoff due to hazardous material spills than Alternative 1 for two reasons. First, increased tenant occupancy of existing buildings creates increased requirements for specific hazardous materials, such as custodial chemicals and pesticides, necessary for the continued O&M of the facilities that would not normally be used when the facility is under "zero maintenance". Second, although potential leasing tenants are primarily administrative in nature at the present time, the land use changes under Alternative 2 include the potential for future tenants that perform "equipment and maintenance" functions that could bring increases in industrial hazardous material storage and usage associated with their activities (see FSH PEIS for detailed discussion of land use changes associated with Alternative 2). However, despite the greater potential for release, the normal storage and usage of hazardous materials in accordance with established contingency, spill, and pollution prevention plans is likely to mitigate potential spills and prevent a release to the surface waters of FSH. Operations at the installation associated with Alternative 2 are not considered to present a significant negative impact on the area water supply through surface water contamination.

Groundwater

On 5 November 1999, the U.S. Fish and Wildlife Service (USFWS) issued Biological Opinion (BO) 2-15-98-F-759 (USFWS, 1999) on the effects of Edwards Aquifer withdrawals due to military activities. The USFWS concluded that ongoing and proposed area military activities are not likely to jeopardize the continued existence of eight threatened or endangered species, or to adversely modify designated critical habitat. The operation of FSH under both alternatives discussed is considered part of those activities and is therefore covered by the BO. Any increase in water requirement associated with the proposed operation of FSH is to be offset by a corresponding decrease in water use by area military activities, resulting in no increase in the military's overall withdrawal of Edwards Aquifer water (Schlatter, 2001).

Under Alternative 2, the authorized peacetime strength (see Section 2.3.1) would be projected to increase by 2,416 personnel from 18,378 in FY 1999 to a maximum of 20,794 in FY 2005. If the estimated 1999 per capita use of 61 kgals per year remains

constant through 2005, this increase would result in a maximum water demand of 1,268,434 kgal per year (61 kgals x 20,794 personnel).

The average per capita usage is expected to be less than the estimated 61 kgal, because 65 percent of the FSH population (day workers) would only be on the installation 33 percent of the time (U.S. Army, 2000a). However, this analysis uses the larger figure to ensure a conservative computation.

As mentioned, the most conservative annual water usage cap available for use in this analysis was 1,030,704 kgal, established by the San Antonio Military Water Working Group for the year 2002-03. Subtracting this water cap from 1,268,434 kgal (based on the anticipated water demand for 20,794 persons in 2005) results in a 237,730 kgal excess demand from the Edwards Aquifer.

However, the FSH Water Reuse Plan (using reused water for cooling towers and irrigation on FSH), is expected to reduce water demand upon the Edwards Aquifer by 281,688 kgal per year (Schlatter, 2000). Subtracting this reduction from the FY 2005 projected water demand (1,268,434 kgal per year) yields a FY 2005 Edwards Aquifer demand of 986,746 kgal. This figure is 43,985 kgal per year below the 2002-03 authorized water cap and therefore does not amount to a negative impact on the Edwards Aquifer (see Table 4-1).

Floodplains, Waterways, and Wetlands

Impacts to floodplains, waterways, and wetlands under this alternative would be similar to those described for Alternative 1.

4.1.5 Biological Resources – FSH

4.1.5.1 Alternative 1

Flora

Alternative 1 should have no significant adverse impacts on flora at FSH. FSH has been developed over the last 100 years to accommodate the various structures and services required for the assigned mission. As a result of this development, much of the land was converted from Blackland Prairie to landscaped yards, gardens, and grounds. Past landscape management practices have promoted the preservation of this area, and the post's Historic Landscape Master Plan (USACERL, 1995) has encouraged the survival of large native trees and the cultivation of a variety of exotic vegetation throughout the historic areas of the post. Any new activities or construction associated with the proposed action would occur at or near current structures in already disturbed land. Renovation and rehabilitation, as well as building demolition, would take place in already existing structures. These activities would have little impact on the urban flora that exists in the area.

Alternative 1 is consistent with past and present missions and would not require the disturbance of the natural habitat provided by the Salado Creek floodplain. The biota along the creek and in the floodplain in this area are essentially the only relatively undisturbed biological communities on FSH.

Fauna

Alternative 1 would have no significant adverse impacts on fauna located at FSH. In the past, larger animals have vacated the area in response to urban pressure. Bird populations and diversity may have increased as a result of the more varied vegetation. Past development of FSH had a significant impact on the biological resources and ecological balance of the site. However, over the years, a new ecological balance has arisen. The modern balance includes more exotic and landscaped plants and urban-tolerant fauna. The existing mission would not upset this ecological balance.

The Salado Creek floodplain, which comprises 30 percent of the post's land, has been maintained in a natural condition. Human use of the floodplain currently takes place in this urban setting, and large amounts of debris have been deposited along the creek, particularly during floods.

Threatened and Endangered Species

No threatened or endangered species are known to inhabit FSH proper, and therefore Alternative 1 would have no impacts on any threatened or endangered species on the post. However, FSH does have an impact on Edwards Aquifer and therefore potentially the eight threatened or endangered species that rely on minimal springflows for their continued survival. The Biological Opinion issued by the USFWS on 5 November 1999 (Appendix B) concluded that, by applying water withdrawal caps and implementing staged reductions during drought conditions at FSH, mission activities associated with Alternative 1 are unlikely to have an adverse impact on the continued survival of the species or adversely modify designated critical habitat (USFWS 1999; Schlatter, 2000).

4.1.5.2 Alternative 2

Alternative 2 differs from Alternative 1 in that it would result in the reuse of currently vacant facilities, including some historical buildings on FSH. This reuse, including any required rehabilitation, would not significantly impact biological resources. Impacts to threatened or endangered species under Alternative 2 would be similar to those associated with Alternative 1.

4.1.6 Land Use and Visual Resources – FSH

4.1.6.1 Alternative 1

On-Post Land Use

Under Alternative 1, FSH's population is expected to decrease 3.6 percent between 1999 and 2005 (see Section 3.1.6). Overall, land use intensity of the installation, traffic, and levels of activity would be similar to current conditions through 2005, and no significant adverse impacts to land use are anticipated. During mobilization, when installation population can increase significantly, increased activity, congestion, and site density would be noticeable, but short-term. Because planning considers these extreme requirements, and buildup is organized and temporary, the effect on land uses would be minor.

As discussed in more detail in the FSH PEIS, 29 construction projects are identified for the FY 1999-2008 period, and 15 other facility sitings are planned (U.S. Army, 2000a).

In general, these projects either meet an existing or projected shortfall in capability or capacity of a specific facility type, replace deteriorated or substandard facilities, improve efficiency, or provide a quality of life benefit for military employees and residents. As such, they improve conditions on the installation. For projects that have a known site selected, no conflicts or incompatibilities are expected between new facilities and existing or proposed land uses. Sites have not been selected for all projects. Prior to construction, proposed sites will be reviewed and approved by the Installation Planning Board (including a required environmental review) for consistency with land use plans, environmental regulations, and other activities.

A total of 2,679,400 square feet of facilities may be considered for management action. As with construction, these actions generally support real property master planning goals for maintaining good quality facilities that meet military missions. Similar to other urban environments, removal of deteriorating buildings can benefit public safety and create opportunities for future redevelopment.

Effects associated with proposed demolition and disposal of facilities are deemed to be temporary and isolated to the immediate area of demolition. Similarly, reuse and construction often present only temporary issues with no foreseen long-term negative impacts. Under normal conditions, new and replacement facilities are periodically required and demolition of existing facilities necessary. For these circumstances, a NEPA environmental evaluation process for individual projects has been established and is managed by ENRO, United States Army Garrison. The program is designed to ensure that future proposed actions are individually evaluated, particularly in view of the significant cultural resource concerns at FSH.

Real property master planning guidance documents for FSH strongly support goals to cost-effectively sustain the cultural environment. Where renovation or reuse is feasible, an attempt to incorporate cultural preservation into the project is evaluated, but is not always achievable. The removal of buildings categorized as Historic Categories I, II, and III could be detrimental to historic attributes of much of the land area of FSH. While these attributes do not define land use categories on the installation, the designation of historic districts has introduced this purpose into land use management. The City of San Antonio is also concerned with cultural preservation and has designated historic districts as a means of protecting cultural resources. As such, demolition of historic structures in these areas is not consistent with land use management goals and objectives. Because of this, implementation of the Military Housing Privatization Initiative (MHPI) and Residential Communities Initiative (RCI) would benefit land use on FSH by preserving historic housing through the use of private funds and keep them in use by Army families.

The Independent School District is considering constructing a new Middle School on FSH just southeast of the existing High School. The building site would be above the Salado Creek floodplain and is appropriately located for sharing resources between the two schools. Additional traffic on Winan Road and its intersection with Harry Wurzbach Road should be considered in the overall plan for this project.

The central area of the installation (south Harris Heights) is proposed to undergo a transition to include more community support uses for medical campus and student housing-type development. A portion of the accessible land would be transferred to the Veteran's Administration to expand the national cemetery, and the N4A training area on the east side of the installation would be converted to family housing and recreational

uses. The new BAMC area would also experience some consolidation of services and troop housing facilities within its enclave. None of these changes is likely to conflict with adjacent activities if appropriate buffering is incorporated during development and modifications, where necessary.

The facility management actions planned for FSH would have little direct effect on surrounding off-post areas, except as noted above. Removal of older facilities along the boundary of the Government Hills neighborhood should reduce the nuisance of deteriorating facilities.

Aesthetics

Because of its long history, FSH has an abundance of historic resources that have contributed to its visual environment. Distinctive visual typologies have evolved due to its original role as a fort and, later, as medical center for the Army. Several new projects may be constructed on FSH over the next several years. New construction could change sensitive contexts and influence the visual character in localized areas of the installation. A commitment to managing its visual resources is evident in master planning goals, the *Cultural Resources Management Plan* (CRMP) (USACE, 1997b), and the in-depth treatments prescribed in the *Installation Design Guide* (IDG) (U.S. Army, 1991b) and the *Historic Landscape Master Plan* (USACERL, 1995). These documents define different zones and prescribe appropriate visual image, siting parameters, land use, and architectural and landscape treatments for each zone. The IDG also lists functional agencies and their areas of responsibility in the master planning design review process on FSH. Each new project undergoes review and will be designed consistent with these guidelines, thereby minimizing the potential for incongruent construction and adverse visual changes.

Facility removals can also change the visual environment, leaving voids in the visual "fabric". This is particularly critical for historic buildings where context is a protected attribute. Such impacts of removals on cultural resources are addressed in Section 4.1.8. The removal of isolated buildings would not generally alter the overall image of an area unless it interrupted a distinctive pattern or rhythm in the layout of buildings in an area. In some cases, cleared sites would be redeveloped and voids would only be short-term. Assuming an overall perspective, facility construction and removals are part of the organic development of the installation. Treatment of new structures would need to conform to IDG and landscape guidelines to preserve and maintain the essential visual character of the installation.

A specific project that may have adverse visual impacts is the possible privatization of the Artillery Post Housing along Artillery Post Road. These structures form a definitive edge and rhythm along the end of the Parade Ground and contribute to definitive character in this portion of the National Historic Landmark District.

Similarly, removal of Harris Heights housing without replacement would alter the visual context near the AMEDDC&S campus and existing troop housing. In both cases, rehabilitation or replacement with structures of similar architectural character and scale would mitigate impacts.

A pressing issue for FSH is the cost of maintaining vacant, historic buildings. With limited resources, many vacant structures are deteriorating and becoming unsightly and

unsafe. While dilapidated structures appeal to some individuals, maintaining visual orderliness is an important aspect of FSH's historic and modern-day image. Removal of deteriorating facilities can be a visual improvement and contextually appropriate.

4.1.6.2 Alternative 2

On-Post Land Use

Alternative 2 involves the adaptive reuse of facilities and property at FSH by Federal users and differs from the No Action Alternative through the proposed backfilling of some currently vacant facilities, including some historical buildings, or an increase in available funding for maintenance of historical properties from traditional governmental sources. Under this alternative, FSH's population is expected to increase 13.1 percent between 1999 and 2005 (see Section 3.1.7) should adaptive reuse be maximized.

Overall, adaptive reuse of facilities would be consistent with the installation's real property master planning goals and objectives and would not result in significant adverse impacts to land uses. Use of the Beach Pavilion Complex, the former Main Hospital, and other former Main Hospital facilities by other DoD and Federal users for administrative, instructional, medical, or similar uses would be consistent with designated land use categories and would be compatible with adjacent uses. Compatibility of proposed land use changes with surrounding existing activities as shown on Figure 4-1, Proposed Land Use Plan, is described in Table 4-2 below. The proposed changes are compatible with surrounding land uses. IDG standards would be incorporated into future site developments and siting decisions (U.S. Army, 2000a).

Under Alternative 2, installation planning decision-makers would continue to relocate tenants among existing buildings to increase efficiency and maximize building use, as described for Alternative 1. In general, this is a desirable strategy for managing and preserving facilities and resources. Decisions will evaluate the proposed reuse in terms of previous uses and surrounding activities.

Effects associated with proposed demolition and disposal of facilities are deemed to be temporary and isolated to the immediate area of demolition. Similarly, reuse and construction often present only temporary issues with no foreseen long-term negative impacts. Under normal conditions, new and replacement facilities will periodically be required and demolition of existing facilities will become necessary. Several significant construction and demolition projects proposed for the foreseeable future could impact land use at FSH (U.S. Army, 2000a). Under these circumstances, a NEPA environmental evaluation process for individual projects has been established and is managed by the Public Works Business Center (Environment and Natural Resources Division). The program is designed to ensure that future proposed actions are individually evaluated, particularly in view of the significant cultural resource concerns at FSH.

Privatization of utilities would have no impact on land use. It is assumed that private purveyors would provide the level of service required by FSH. Future system expansions may need to be assessed for potential environmental impacts. Additional personnel associated with the adaptive reuse strategy would increase traffic on local access roads; however, this would not exceed past levels when these facilities were active and fully operational and would not impact land uses.

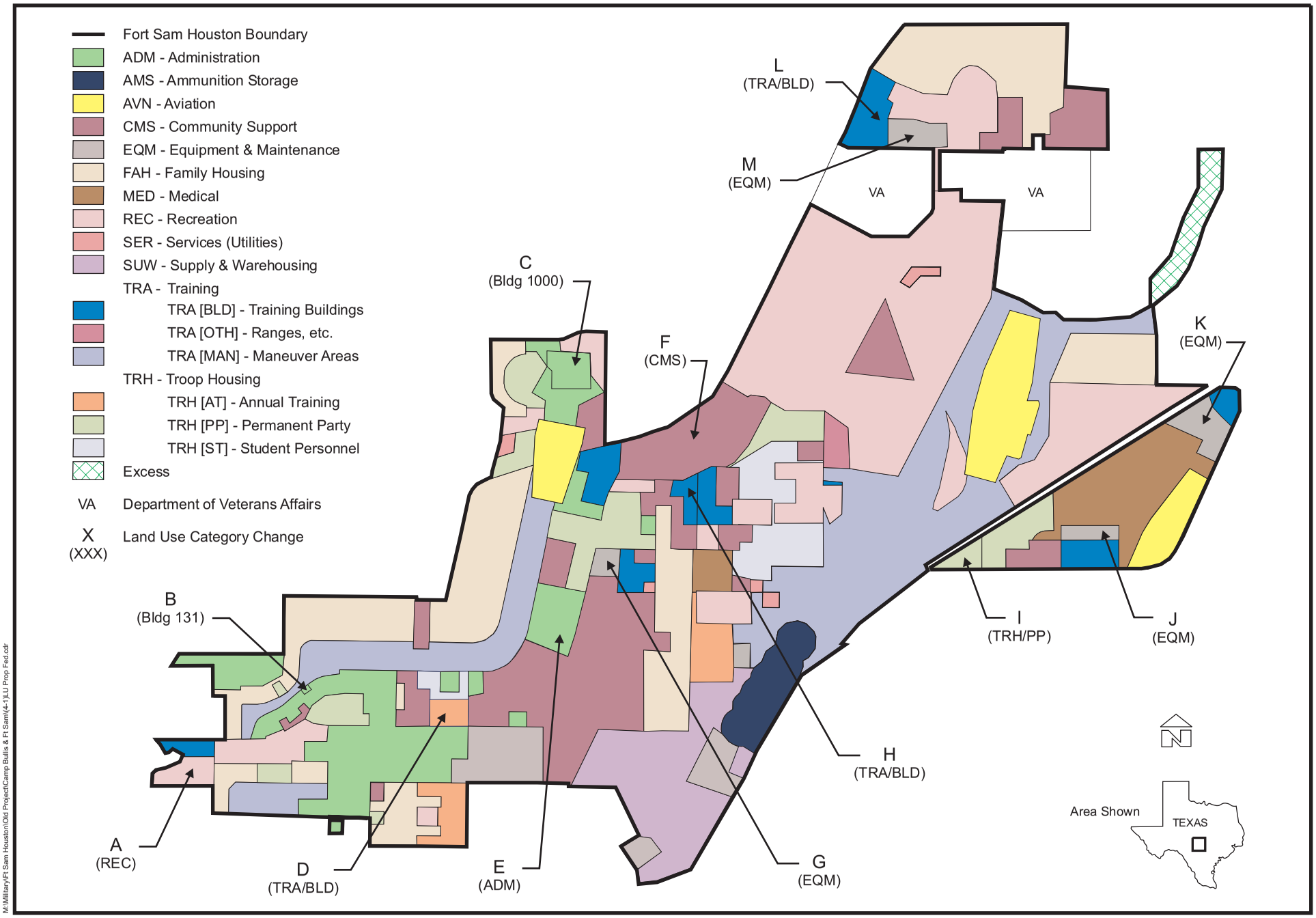


Figure 4-1 -- Fort Sam Houston Proposed Land Use - Federal

Table 4-2 Compatibility of Proposed Land Uses with Existing Land Uses

Area Designation*	Existing Land Use	Proposed Land Use	Compatibility
A	Training Buildings	Recreation	Recreational use compatible with off-post community and may enhance community if planned cooperatively with neighborhood.
D	Active Troop Housing	Annual Training Buildings	Training use compatible with surrounding medical and administrative uses.
E	Training Buildings	Administrative Buildings	Administrative use compatible with surrounding medical use.
F	Family Housing	Community Support	Community support compatible with installation campus activities and frontage on Harry Wurzbach Road.
G	Supply	Equipment & Maintenance	Equipment and maintenance use similar to current supply use.
H	Community Service	Training Buildings	Training uses would expand medical campus and improve links between educational facilities and student housing.
I	Recreation	Permanent Troop Housing	New troop housing area replaces recreation and is near training and work locations at BAMC, improves efficiency, adequate alternate recreation areas.
J	Medical	Equipment & Maintenance	Equipment and maintenance functions for BAMC to provide efficient staging for hospital; displaces some parking areas.
K	Training Buildings	Equipment & Maintenance	Equipment and maintenance functions for BAMC replace undeveloped training building areas to provide efficient staging for hospital.
L	USAR (Western Portion)	Training Buildings	Training buildings defined for current USAR enclave, compatible with frontage on Harry Wurzbach Road.
M	USAR (Eastern Portion)	Equipment & Maintenance	Equipment and maintenance areas consistent with current use; adjacent community areas compatible, but visual screening between community and industrial-type uses desirable.

Source: U.S. Army, 2000a.

* As shown on Figure 4-1 (Proposed Land Use Plan)

Aesthetics

The aesthetics issues discussed above regarding Alternative 1 pertain equally to Alternative 2.

4.1.7 Socioeconomics – FSH

4.1.7.1 Alternative 1

Population

Population projections under Alternative 1 show an incremental population decrease of 3.6 percent in the overall population affiliated with FSH between 1999 and 2005 (see Table 3-11, FSH Population Profile). This decrease represents only 0.04 percent of the 1999 San Antonio MSA population (1,552,124), and a decrease of 640 personnel associated with FSH would not negatively impact FSH or the San Antonio MSA.

Employment and Income

Maintaining the ongoing overall mission of FSH would result in the continued employment of civilians and military personnel affiliated with FSH. As noted in Table 3-11, the population at FSH, including military and civilians, was estimated at 18,378 for FY 1999. This figure includes more than 7,217 civilian jobs with relatively high salaries. As mentioned, under this alternative, the population affiliated with FSH is expected to decrease 3.6 percent through 2005. The total positive economic impact by FSH (including Camp Bullis) on the San Antonio region was estimated at approximately $695 million in 1999, as outlined in Section 3.1.7.2. This includes a military, civilian, and National Guard/Reserve payroll of $555 million and other economic activities totaling $139 million. These sums represent not only direct salary payments to persons affiliated with FSH, but also contributions to the regional economy through a multiplier effect whereby the economic benefits of local spending extend beyond the purchase of goods and services into additional growth through reinvestment in the region. Maintaining the current mission at FSH, even with the projected small incremental reduction in personnel levels through 2005, would continue the infusion of money and derivative economic benefits, including employment opportunities, although there would be a slight reduction in the positive economic impact of FSH on the San Antonio MSA.

Housing

Under Alternative 1, FSH's military population (including personnel associated with Camp Bullis) is projected to decrease by 44 people between 1999 and 2005, while the civilian population is projected to decrease by 596 people during the same period. FSH currently has a shortfall of available on-post housing for eligible families affiliated with the installation (approximately 850 families are on a waiting list for on-post housing). Alternative 1 would decrease the demand for on-post housing incrementally through 2005, thereby alleviating some of the current backlog. Even with this reduction, however, the majority of the military population would likely reside off-post until such time as on-post housing becomes available, while all of the civilian population would continue to procure housing in the surrounding San Antonio MSA. No adverse impacts are anticipated upon the existing housing stock in the area.

A number of construction projects planned or underway at FSH to deal with the shortfall in on-post housing are detailed in the FSH PEIS, including:

- New BAMC Barracks intended to house 332 personnel;
- New 150-room guesthouse;
- Planned construction of a 283,000 SF Trainee Barracks;
- Replacement of Barracks 2265 with 288 new barracks, scheduled for completion in 2011; and
- Revitalization of Patch/Chaffee family housing quarters.

Implementation of programs such as MHPI and RCI (see Section 3.1.6.1) at FSH could also help alleviate the shortfall in available on-post housing for military personnel and their dependents.

The construction/demolition phases of housing projects at FSH would provide a short-term economic benefit for the construction industry in the area. Moving families into installation housing and out of regional housing would cause a minimal short-term impact on the San Antonio MSA by increasing vacant housing. However, no long-term or significant negative impacts relating to housing are expected.

Community Services and Education

FSH provides medical care to military personnel through BAMC and through smaller clinics. Unless a major emergency arises, fire, rescue, and other services are provided on FSH with no need for other local assistance. Mutual assistance agreements with local fire and medical organizations enable FSH to provide emergency assistance to civilian organizations and for local providers to do the same for FSH, if required. For example, BAMC receives civilian air ambulance emergency patients. The incremental population decrease of 3.6 percent between 1999 and 2005 associated with Alternative 1 is not expected to have an impact on the ability of FSH to continue to receive these patients.

Both military and civilian personnel affiliated with FSH who would live in the local community would use the existing community services. Their impact on fire, rescue, medical, and police services within their individual neighborhoods is considered insignificant because they represent a very small percentage of the population within the San Antonio MSA (see Tables 3-12 and 3-13). No impacts to these resources are expected to result from the projected 3.6 percent decrease in population through 2005.

The decrease in the military population at FSH through 2005 associated with the Alternative 1 may cause student loads to decrease in the FSH ISD. As a result, the elementary school, whose enrollment for the 1999-2000 school year approached the maximum enrollment capacity of 800 students, may be reduced, but by a very small percentage of the student population within the San Antonio MSA.

Through the RCI, new housing projects could be sold to a developer, and then would no longer be considered part of FSH. Because students who live in these homes would be required to attend local schools off-post, fewer students may attend schools with the

FSH ISD. Also, because parents who do not live on Federal property would pay local taxes, some of which supports local school districts, Federal impact aid paid to local schools would decrease from approximately $2,000 to $200 per student.

However, an option under the RCI is to deed only the newly constructed facilities to the developer and retain title to the underlying land. In this case, the land would be considered Federal, students could then attend the FSH ISD, and the $2,000 in Federal impact aid for each student would be paid annually to the FSH ISD. As plans to use the RCI become more concrete, additional analyses will be required.

4.1.7.2 Alternative 2

Population

Population projections for Alternative 2 indicate that the total population of FSH is expected to increase by 13.1 percent from 1999 to 2005. This increase of 2,416 people through 2005, which represents only 0.1 percent over the 1999 population of the San Antonio area (1,552,124) (Table 4-3), would occur incrementally and would not significantly impact FSH or the San Antonio MSA.

Table 4-3 Potential Maximum Authorized Strength Under Adaptive Reuse by Federal Users, FY 1999 through FY 2005

	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005
Military	11,161	10,970	11,948	11,700	11,849	12,032	12,032
Civilians	7,217	7,206	7,480	7,907	8,336	8,762	8,762
Total	**18,378**	**18,176**	**19,428**	**19,607**	**20,185**	**20,794**	**20,794**

Source: U.S. Army, 2000a

Employment and Income

As noted in Table 4-3, the aggregate authorized population at FSH, including military and civilians, was set at 18,378 for FY 1999. Based on FSH's FY 1999 employment and procurement estimates, the positive economic impact upon the regional economy was calculated to be $695 million (see Section 4.1.7.1). Alternative 2 would increase employment of civilians and military personnel affiliated with FSH through adaptive reuse of facilities by 13.1 percent through 2005. As a result of this population increase, the positive economic impact to the regional economy would expand due to an infusion of money from new jobs and procurement. This spending would also feed the economy of the region through a multiplier effect whereby local spending results not only in the purchase of goods and services, but in additional growth through reinvestment in the region.

Housing

Under Alternative 2, FSH's military population (which includes personnel associated with Camp Bullis) is projected to increase by 871 people between 1999 and 2005, while the

civilian population associated with adaptive reuse is projected to increase by 1,545 people during the same period. FSH has a shortfall of available on-post housing for eligible families affiliated with the installation (approximately 850 families are on a waiting list for on-post housing). Alternative 2 would increase the demand for on-post housing incrementally through 2005. The majority of the military population likely would reside off-post until such time as on-post housing becomes available, while all of the civilian population would procure housing in the surrounding San Antonio MSA. The existing housing stock in the area is deemed adequate to support this influx, and no significant negative or long-term impacts are anticipated.

A number of construction projects planned or underway at FSH to deal with the shortfall in on-post housing are detailed in the FSH PEIS (U.S. Army, 2000a), including:

- New BAMC Barracks intended to house 332 personnel;
- New 150-room guesthouse;
- Planned construction of a 283,000 SF Trainee Barracks;
- Replacement of Barracks 2265 with 288 new barracks, scheduled for completion in 2011; and
- Revitalization of Patch/Chaffee family housing quarters.

Implementation of programs such as MHPI and RCI (see Section 3.1.6.1) at FSH could also help alleviate the shortfall in available on-post housing for military personnel and their dependents through privatization initiatives.

The construction/demolition phases of housing projects at FSH would be a short-term economic benefit for the construction industry in the area. Moving families into installation housing and out of regional housing would provide a minimal short-term impact on the San Antonio MSA by increasing vacant housing. However, no long-term impacts relating to housing are expected.

Community Services and Education

FSH provides medical care to military personnel through BAMC and through smaller clinics. Unless a major emergency arises, fire, rescue, and other services are provided on FSH with no need for other local assistance. Mutual assistance agreements with local fire and medical organizations enable FSH to provide emergency assistance to civilian organizations and for local providers to do the same for FSH, if required. For example, medical helicopter evacuation services are regularly provided to the civilian community through BAMC. The incremental population increase of 13.1 percent between 1999 and 2005 associated with Alternative 2 is not expected to have an impact on the ability of FSH to continue to provide these services.

Both military and civilian personnel affiliated with FSH who would live in the local community would use the existing community services. Their impact on fire, rescue, medical, and police services within their individual neighborhoods is considered insignificant because they represent a very small percentage of the population within the San Antonio MSA (see Tables 3-12 and 3-13). No additional impacts to these resources

are expected as a result of the projected 13.1 percent increase in the population affiliated with FSH through 2005. It is anticipated that the great majority of the added personnel at FSH would be persons who already live in the San Antonio MSA.

The increase in the military population at FSH as a result of Alternative 2 may cause student loads to increase in the FSH ISD. In particular, the elementary school, whose enrollment for the 1999-2000 school year approached the maximum enrollment capacity of 800 students, may be impacted. Once adaptive reuse is underway, further study would be required to assess the impacts, if any, on the FSH ISD. Impacts from students affiliated with FSH who attend a school outside the FSH ISD would be minimal because the number of students would represent a very small percentage of the student population within the San Antonio MSA.

The Alternative 1 discussion of potential RCI impacts on schools (Section 4.1.7.1) applies equally to Alternative 2.

4.1.8 Cultural Resources – FSH

4.1.8.1 Alternative 1

Archaeological Resources

Alternative 1 should have no negative impacts on the seven known archaeological sites on FSH. Although these sites have been determined to be ineligible for inclusion on the NRHP, their locations are being protected to forestall vandalism or looting. Additionally, the FSH CRMP (USACE, 1997b) requires parties involved with construction or demolition activities to coordinate plans with appropriate cultural resource personnel. The CRMP recommends that any ground-disturbing activity, especially in the pre-1930 landmark district, consider the possibility that historic archaeological resources may be intact and have buried cultural deposits. If these procedures are followed, cultural resource management at FSH will be enhanced, resulting in a positive impact.

Architectural Resources

Under Alternative 1, a number of significant properties (Historic Categories I, II, and III) may be demolished, left vacant, or reused (see FSH PEIS for a detailed discussion of the specific underutilized/unused properties potentially involved in construction, demolition, rehabilitation, or renovation). Any building demolitions in those categories would constitute a significant adverse impact, as defined by Section 106 of the NHPA (Subsection 800.9(b)). Demolition of Historic Category IV or V properties, considered insignificant or detrimental to the installation, would have no adverse impact (U.S. Army, 2000a).

The continuation of zero-maintenance procedures, as well as disconnection of utilities in vacant buildings, would result in adverse impacts to architectural resources at FSH. Under Section 106 of the NHPA, these procedures, considered “neglect of a property resulting in its deterioration or destruction,” are identified as adverse undertakings and are considered as adverse impacts.

Facility construction under Alternative 1 includes new construction and existing facility renovation or rehabilitation (see FSH PEIS for detailed discussion of specific properties underutilized or unused and considered for renovation/rehabilitation). Any renovation or

rehabilitation of significant properties (Historic Categories I, II, III) is required by the CRMP and Programmatic Agreement (PA) of 1997 (DoD, 1997) to use the *Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings* (Secretary of the Interior, 1995). Use of these guidelines would ensure that there are no adverse impacts on significant properties. Under the stipulations of the 1997 PA among the Army, ACHP, and the Texas SHPO, any new construction near an Historic Category I, II, or III property requires review by the SHPO to ensure that the new design is compatible with the historic character-defining features of the surrounding significant properties (U.S. Army, 2000a).

A reduction in resources to maintain and rehabilitate the Artillery Post Housing (Historic Category I) could have an adverse effect if it causes or allows sufficient deterioration that affects character-defining features of the significant buildings. Under the MHPI and RCI, it is possible that the Army could partner with a private developer to rehabilitate the Artillery Post Housing. A Community Development Management Plan would have provisions to maintain the historic characteristics of these buildings and the parade ground. If this plan requires the *Secretary of the Interior's Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings,* the rehabilitation would not have an adverse impact.

Alternative 1 assumes that the current leasing arrangement would be maintained and that no additional leasing would be considered. Under the current leasing arrangement, Private Organization Operation (Society for the Preservation of Historic Fort Sam Houston) is listed. The organization rehabilitated the Stilwell House (Historic Category I) under an outgrant lease. This rehabilitation used the *Secretary of the Interior's Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings* and is an example of successful preservation of a significant building using a private partner. Any leasing arrangement to rehabilitate further buildings that stipulates the use of the *Secretary of the Interior's Guidelines* would be considered to have no adverse impact (U.S. Army, 2000a).

This alternative's continuation of zero-maintenance procedures for vacant historic properties could result in adverse impacts to those significant properties and surrounding historic landscape resources. Properties proposed for zero-maintenance procedures, including those within identified significant historic landscapes or designated NHLDs (including the Infantry Post, the Artillery Post, the Beach Pavilion Complex, the former Main Hospital building, the 2100 series buildings, and the 600 series buildings), will be subject to vandalism and deterioration. The degradation of these buildings and landscapes constitutes an adverse impact to historic properties (U.S. Army, 2000a).

4.1.8.2 Alternative 2

Archaeological Resources

Under Alternative 2, an increase in installation personnel and programs has the potential to impact archaeological resources if the assignments or programs involve an increase in ground-disturbing activities. However, if the CRMP is complied with (including the mitigation mandates of the NHPA), there should be no significant adverse impacts on known archaeological resources at FSH. A positive impact may be realized if new resources are discovered and proper protection measures are instituted, pursuant to the CRMP.

Architectural Resources

Under Alternative 2, the Army would continue to be responsible for NHPA compliance and would undertake the adaptive reuse of currently vacant historic buildings by military or other Federal missions using the *Secretary of the Interior's Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings.* This would have the beneficial effect of preserving buildings that would otherwise deteriorate under zero-maintenance management. However, under this alternative, the proposed changes in land use could cause adverse impacts if buildings in Historic Categories I, II, and III are removed rather than reused. Decisions concerning demolition of historic structures or the alteration of historic landscapes to accommodate future military or other Federal missions could create both positive and negative impacts on cultural resources at FSH. If decisions are guided by the mandates of the NHPA, the CRMP, and the 1997 PA, overall impacts on the cultural resources of FSH should be positive.

4.1.9 Utilities/Infrastructure – FSH

4.1.9.1 Alternative 1

The privatization of the utilities on FSH would transfer the utility infrastructure to a private/public sector organization that would take responsibility for owning, maintaining, repairing, and eventually disposing of or replacing the systems. Assuming that the 1998 level of total use of electricity and natural gas for FSH will be held constant or decline, based on ongoing conservation measures and the projected 3.6 percent decline in the peacetime authorized strength, no significant changes in demand for these utilities is expected; hence no significant adverse impacts are foreseen.

Water use on FSH averaged 1,126,104 kgal per year from 1990 to 1999. The average annual per capita usage, assuming the 1999 installation authorized strength of 18,378, is 61 kgal. Under Alternative 1, the peacetime authorized population of FSH is projected to decline slightly (from 18,378 in FY 1999 to 17,738 in FY 2005). As discussed in Section 4.4.1.3, above, assuming that the per capita rate remains constant through 2005, this decrease would equal a demand of 1,082,018 kgal per year by 2005, a reduction of 30,940 kgal per year. This decrease, combined with the estimated 281,688 kgal per year reduction through the FSH's Water Use Reduction Program, results in an annual water demand of 800,330 kgal, well below the 2002-2003 authorized annual Edwards Aquifer target water cap of 1,030,704 kgal (note: DoD components have not yet apportioned the water for 2004-2005). Therefore, under Alternative 1, FSH's reduction of water demand from the Edwards Aquifer below the annual target water use cap would have a positive impact on the aquifer and on water available for consumption in the San Antonio area.

4.1.9.2 Alternative 2

As shown in Table 2-4, the peacetime authorized strength for military and Federal agency population at FSH could increase by 2,416 personnel (13.1 percent) between 1999 and 2005. Although the population would increase under Alternative 2, ongoing conservation practices are expected to maintain or reduce the total utility use through this period. These assumptions result in a decrease in per capita use of electricity and natural gas consistent with the trend from 1996 to 1998.

The use of electricity would decrease from approximately 10,000 to 8,500 kWH per capita per year between 1998 and 2005. Natural gas use would also decrease from approximately 25 to 21 thousand cf per capita per year between 1998 and 2005. No significant negative impacts are foreseen with respect to electricity use.

Under Alternative 2, per capita water usage is assumed to remain the same as discussed under Alternative 1, above, or 61 kgal per year. The anticipated 2,416-person population increase would result in a water demand of 1,268,434 kgal by 2005. This increase in demand would be met through the continued implementation of the Water Use Reduction Program (including a reduction of approximately 281,688 kgal per year through water reuse), for a total demand of 986,746 kgal per year, which is below FSH's target annual water cap of 1,030,704 kgal. Under either Alternative 1 or 2, FSH will reduce water demand from the Edwards Aquifer below the annual target water use cap, and that will have a positive impact on water available for consumption in the San Antonio area.

4.1.10 Transportation and Circulation – FSH

4.1.10.1 Alternative 1

Traffic is not considered a problem at FSH. Existing road networks are adequate for the traffic flow and have handled significantly larger installation populations in the past. However, if a major military mobilization occurs, traffic volumes could increase as much as 75 percent. This increase would cause congestion on the current installation roads.

The completion of the IH-35 overpass allows easier, direct access to BAMC for both private citizens and emergency vehicles. In addition, the replacement of the original low-water crossing with an elevated four-lane bridge where Benz Engleman road crosses Salado Creek has alleviated the traffic congestion caused by the flooding when Salado Creek overflowed its banks.

4.1.10.2 Alternative 2

Although this alternative would increase installation population by 2,416, minimal foreseeable transportation impacts would be associated with that increase.

The discussion of traffic impacts under Alternative 1, above, applies equally to this alternative. No significant adverse impacts are anticipated. The installation has had larger base populations in the past, and the road network can easily handle this small increase.

4.1.11 Recreation – FSH

4.1.11.1 Alternative 1

On-post facilities are used almost exclusively by those living on FSH. Those living off-post often find it more convenient to use recreation facilities close to their homes rather than traveling to FSH. However, the City of San Antonio does not view FSH as a major user of its recreation facilities in comparison to heavy tourist use. Therefore, no adverse impacts to recreation resources in the City of San Antonio are likely to result from ongoing mission activities at FSH.

4.1.11.2 Alternative 2

Although this alternative is expected to increase installation population by 2,416, the foreseeable impacts upon FSH recreation facilities are deemed negligible. The majority of the increase in population under this alternative is to be civilian. The post recreation facilities can easily assimilate the anticipated growth in military population.

The other discussion of impacts to recreation facilities in the San Antonio area under Alternative 1, above, apply equally to this alternative. No significant adverse impacts are anticipated.

4.1.12 Hazardous Materials/Hazardous Waste and Solid Waste – FSH

This section addresses the potential environmental impacts associated with the alternatives caused by hazardous materials, hazardous wastes, and other waste management activities at FSH.

4.1.12.1 Alternative 1

4.1.12.1.1 Hazardous Materials

Under Alternative 1, hazardous materials would continue to be used at FSH in similar types and quantities as those currently used. A slight, temporary increase in the types and quantities of hazardous materials may occur as part of planned construction and renovation activities. This increased usage, however, would occur over a short duration and for the limited time frame of a specific construction activity. The quantities of these materials are expected to be small to moderate and will be managed in accordance with applicable Army regulations and the *FSH Oil and Hazardous Substances Emergency Contingency Plan*, which includes the proper contacts and procedures to be followed in the event of a hazardous substance spill (USACE, 1998a).

All hazardous materials involved with this alternative will be managed, stored, and used in accordance with applicable regulations and established installation protocols. Therefore, no adverse impacts associated with hazardous materials management, storage, or usage are expected under this alternative.

Storage Tanks

Under this alternative, minor impacts to storage tank management could result from potential demolition activities. Any tanks associated with buildings that are proposed for demolition will be removed from the site under the management of PWBC, in accordance with applicable Army and state regulations.

Construction of new facilities could increase fuel storage capacity requirements on FSH, primarily for buildings that require fuel for standby power generators or auxiliary power units. All new tank installations and operations would be managed in accordance with Army and state regulations. Therefore, no adverse impacts to petroleum storage practices at FSH are expected under this alternative.

Pesticides

Pesticide use requirements may fluctuate from year to year, depending upon the net increase or decrease of building square footage in any particular year. The types of

pesticides used on FSH and the location and capacity of existing pesticide storage areas are not expected to change. In all cases (increase or decrease in building area), pesticides will continue to be managed in accordance with the FSH IPMP, which requires adherence to state and Federal regulatory requirements. Therefore, no adverse impacts resulting from pesticide management and use at FSH are expected under this alternative.

4.1.12.1.2 Hazardous Waste Management

Under Alternative 1, no significant change in hazardous waste generation is expected at FSH. The types of facilities (e.g., instructional, administrative, housing) that are proposed for construction/renovation under this alternative are not likely to generate any significant or new hazardous waste. However, hazardous waste storage at FSH will increase due to the relocation of the Defense Reutilization and Marketing Office (DRMO) complex to FSH under a Base Realignment and Closure action at Kelly AFB. Other than additional storage requirements for the DRMO, no significant increases in regulated hazardous waste generation (i.e., > 100 kilograms) are expected under this alternative and no changes to generator classification are anticipated.

Hazardous waste streams generated at FSH would continue to be managed in accordance with the Installation Hazardous Waste Management Plan, SPCCP, and the ISCP (U.S. Army, 1993a). None of the planned construction or operational activities is expected to require additional satellite accumulation sites, although the DRMO facility would likely be considered a less-than-90-day storage area. Therefore, no adverse impacts associated with hazardous waste generation, management, or storage are expected under this alternative.

4.1.12.1.3 Medical and Biohazardous Waste

Under this alternative, four new medical-related facilities are planned for construction at FSH. However, because the missions that will be housed by the new construction are already present at FSH, the construction will simply relocate the existing missions to a more modern facility. No net increase in the generation of RMW and no changes in the management of RMW would be expected. RMW generated at FSH would continue to be managed, accumulated, and disposed of in accordance with applicable regulations and protocol. Therefore, no adverse impacts to RMW management are expected under this alternative.

4.1.12.1.4 Low-level Radioactive Waste

Under this alternative, four medical-related facilities are planned for construction at FSH. However, because the missions that will be housed by the new construction are already present at FSH, the construction will simply relocate the existing missions to a more modern facility. No net increase in the generation of LLRW and no changes in the management of LLRW would be expected. LLRW generated at FSH would continue to be managed, accumulated, and disposed of in accordance with applicable regulations and protocol. Therefore, no adverse impacts to LLRW management are expected under this alternative.

4.1.12.1.5 Installation Restoration Program

Under this alternative, no IRP sites would be disturbed or otherwise impacted by the proposed activities. The IRP sites at FSH would continue to be managed in accordance with applicable Federal and state regulations until closure.

4.1.12.1.6 Solid Waste Management

Under this alternative, solid waste generation is expected to remain essentially constant or slightly decrease by 2005. Solid waste management and disposal will continue through a private, licensed hauler, with disposal off-site at a private/municipal landfill. No adverse impacts to solid waste management are expected under this alternative.

4.1.12.1.7 Wastewater

Wastewater generation due to industrial activities and operation, maintenance, and support functions would remain essentially unchanged under this alternative. Because of the slight decrease in population associated with this alternative, FSH would produce less wastewater. The City of San Antonio will continue to monitor the quality of water that enters its system from FSH. Therefore, no adverse impacts to wastewater management are expected under this alternative.

4.1.12.2 Alternative 2

4.1.12.2.1 Hazardous Materials

Under Alternative 2, hazardous materials would continue to be managed and used as described in Alternative 1, including those required for new construction/renovation activities and operations and maintenance (O&M) of new facilities. Hazardous materials use and storage at FSH is likely to increase slightly under this alternative, compared to Alternative 1, due to the continued O&M requirements (e.g., custodial chemicals, pesticides) associated with the reuse of currently vacant buildings that would have been untended or demolished under Alternative 1. In addition, proposed land use changes under this alternative include designation of four distinct areas at FSH for "Equipment and Maintenance" use. Therefore, future tenants (those not currently forecasted) could include equipment and maintenance activities that use and store hazardous materials.

All hazardous materials introduced by this alternative will be managed, stored, and used in accordance with applicable regulations and established installation protocols. FSH would continue to be responsible for tracking and reporting storage and/or usage of hazardous materials at FSH, including at tenant facilities, under the Emergency Planning and Community Right-to-know Act and other applicable regulations. Therefore, no adverse impacts associated with hazardous materials management, storage, or usage is expected under this alternative.

Storage Tanks

Impacts to storage tank management under this alternative would be the same as those described for Alternative 1.

Pesticides

Under Alternative 2, pesticides would continue to be managed and used as described for Alternative 1. Overall pesticide use at FSH would likely increase under this alternative

as compared to Alternative 1, due to the potential reuse of some buildings under this alternative that would have been untended or demolished under Alternative 1. However, as with Alternative 1, the types of pesticides currently used on FSH and the location and capacity of existing pesticide storage areas would likely not change. In all cases, pesticides will continue to be managed in accordance with the FSH IPMP. Therefore, no adverse impacts to pesticide management and use at FSH are expected under this alternative.

4.1.12.2.2 Hazardous Waste Management

Under Alternative 2, hazardous waste would continue to be managed as described in Alternative 1. Hazardous waste generation at FSH may increase slightly under this alternative, as compared to Alternative 1, because proposed land use changes under this alternative include designation of four distinct areas at FSH for "Equipment and Maintenance" use (U.S. Army, 2000a). Therefore, future tenants (although not known at this time) could include equipment and maintenance activities that generate unknown quantities of hazardous materials.

Hazardous waste streams generated at FSH would continue to be managed in accordance with the Installation Hazardous Waste Management Plan (U.S. Army, 1993a) and the ISCP (U.S. Army, 1998c). None of the planned construction or operational activities under this alternative is expected to require additional satellite accumulation sites. Therefore, no adverse impacts associated with hazardous waste generation, management, or storage are expected under this alternative.

4.1.12.2.3 Medical and Biohazardous Waste

Impacts to regulated medical waste management under this alternative would be the same as those described for Alternative 1.

4.1.12.2.4 Low-level Radioactive Waste

Impacts to LLRW management under this alternative are expected to be the same as those described in Alternative 1.

4.1.12.2.5 Installation Restoration Program

Impacts to IRP sites under this alternative would be the same as those described for Alternative 1.

4.1.12.2.6 Solid Waste Management and Recycling Program

Under this alternative, solid waste generation is expected to increase as a result of the incremental population increase of 2,416 people through 2005. The majority of the increased solid wastes is expected to consist of office-related wastes (paper, cardboard, etc.). Solid waste management and disposal will continue to be accomplished through a private, licensed hauler, with disposal off-site at a private/municipal landfill. FSH will continue to implement recycling and source reduction programs that will reduce the volume of solid waste that requires disposal. Therefore, no adverse impacts from solid waste management are expected to occur under this alternative.

4.1.12.2.7 Wastewater

Under this alternative, the volume of wastewater generated and treated off-site by the City of San Antonio is expected to increase as a result of the incremental population increase of 2,416 people through 2005. Wastewater generation due to industrial activities and operation, maintenance, and support functions is not expected to significantly change under this alternative. The increase in wastewater volumes associated with this alternative would not adversely impact the capacity and ability of the City of San Antonio (San Antonio Water System) to handle this wastewater. The City of San Antonio will continue to monitor the quality of water that enters their system from FSH. Therefore, no adverse impacts to wastewater management are expected under this alternative.

4.2 CANYON LAKE RECREATION AREA

4.2.1 Earth Resources – CLRA

4.2.1.1 Alternative 1

Geology

There are no adverse impacts to the geology of the CLRA associated with Alternative 1.

Soils

Land near Canyon Lake is beginning to show signs of erosion primarily due to pedestrian traffic and erosion of the beach. As undergrowth is removed and development increases, erosion could induce additional degradation (USACE, 1996). Revegetation may be required to minimize erosion rates and stabilize high traffic areas.

Every one or two years, the USACE conducts prescribed burning at the CLRA as a wildlife and habitat management tool. Due to the movement of soil downslope and into the lake, prescribed burning can negatively affect water quality (in terms of increased turbidity) if it is conducted on regions with a slope greater than 45 degrees. Positive effects on soil stability occur when the prescribed burnings enable the establishment of understory plant communities and ground cover species that reduce erosion rates (USACE, 1996). No recreational off-road vehicle use is permitted at the CLRA because of potential erosion problems (USACE, 1996). Therefore, continuation of the existing mission would not negatively impact soils at the CLRA.

4.2.1.2 Alternative 2

Impacts anticipated under Alternative 2 would be the same as described under Alternative 1.

4.2.2 Air Quality – CLRA

4.2.2.1 Alternative 1

None of the activities or operations at the CLRA is expected to have an impact on the climate of the region. Minor emissions result from camping fires and the operation of automobiles and boats at the CLRA. Overall, the CLRA does not have air quality compliance problems, and none is expected to develop with normal continued use of the CLRA.

4.2.2.2 Alternative 2

Impacts anticipated under Alternative 2 would be the same as described under Alternative 1.

4.2.3 NOISE – CLRA

4.2.3.1 Alternative 1

The main source of noise at the CLRA is recreational use of outboard motor boats and occasional aircraft/helicopter flights over the area. Because of the infrequency and short duration of the flights, coupled with the low residential density in the area, the effects are perceived to be negligible. Outboard motor noise does not create a problem because the recreational purpose for the CLRA includes such use, and users of the CLRA are aware of and expect this type of noise.

4.2.3.2 Alternative 2

Impacts anticipated under Alternative 2 would be the same as described under Alternative 1.

4.2.4 WATER RESOURCES – CLRA

4.2.4.1 Alternative 1

Surface Water

Use of the CLRA has had little effect on surface hydrology. All runoff drains into Canyon Lake; however, no pollution problems have been identified with the non-industrial use of the facility and none is anticipated. FSH has also developed a CLRA-specific *Oil and Hazardous Substance Emergency Contingency Plan* (USACE, 1998b). This plan provides prevention and control measures to minimize the potential for accidental spills of any hazardous or toxic chemicals and establishes plans and procedures for handling sudden releases of petroleum products and hazardous materials to minimize the risk of contamination of surface waters.

Construction activities planned for the CLRA under this alternative could alter the soil profiles and natural drainage, which in turn may alter water flow patterns and loadings to Canyon Lake. A recreation billeting facility is planned for construction in FY 2001. In accordance with the CLRA SWPPP (USACHPPM, 1999b) and the FSH Erosion Control Master Plan (USACE, 1993a), best management practices (berm construction, sediment traps, silt fences, wind brakes, etc.) would be implemented where required to minimize any short-term, potential impacts associated with construction. The increase in impervious cover will not be significant (less than 50,000 sf), and no changes to water quality in Canyon Lake is expected (U.S. Army, 2000a).

Groundwater

The CLRA is a recreational facility whose population varies depending on the weather, season, and other factors. The average population and corresponding demand for groundwater resources is not expected to change significantly from the existing conditions under Alternative 1.

Since the CLRA is located in the drainage area for the Edwards Aquifer recharge zone and obtains its water from the Trinity Aquifer, hazardous material spills could impact

groundwater quality. However, because relatively small quantities of hazardous materials are stored and used in accordance with established contingency spill and pollution prevention procedures, it is unlikely that such a spill would contaminate the Edwards Aquifer recharge zone or Trinity Aquifer. Significant impacts on groundwater are not expected.

Floodplains and Waterways

No adverse impacts to floodplains or waterways of the CLRA are associated with Alternative 1.

4.2.4.2 Alternative 2

All impacts expected under Alternative 2 would be the same as described under Alternative 1.

4.2.5 BIOLOGICAL RESOURCES

4.2.5.1 Alternative 1

Flora

Alternative 1 would not have any further significant adverse impacts on flora located at the CLRA. The CLRA ecosystem has been greatly altered by past development and recreational activities. At present, the ecosystem is at an intermediate successional stage and is not yet in ecological balance (U.S. Army, 1991a). That is, the normal Edwards Plateau ash juniper/live oak-prairie vegetation has been severely altered by intense human use since 1965, and has not adjusted to these conditions. If properly managed, high human use areas can attain a certain stability (as observed at FSH); however, a management strategy (e.g., conservation of native forms or replacement with cultivated forms) has not yet been developed for Canyon Lake. Given the altered condition of the existing ecosystem, the continued use of the CLRA should not cause any further significant adverse impacts (USACE, 1996).

Fauna

Alternative 1 would have no significant adverse impacts on fauna at the CLRA. The past establishment of this recreational area required the removal of existing vegetative understory and resulted in a significant reduction of small game habitat. However, wildlife species disturbed during past development likely migrated to the adjacent areas of appropriate habitat. The ongoing FSH mission does not require removal of additional wildlife habitat. The animal control portion of the FSH Installation Pest Management Plan (U.S. Army, 1998b) is directed at species that pose a human medical hazard or a nuisance and should not have a significant impact on the fauna of the CLRA.

Threatened and Endangered Species

Alternative 1 would not have any impact on threatened or endangered species at the CLRA. Past urban development activities have resulted in the removal of suitable unique habitat that may support federally listed threatened or endangered animal and plant species at that location.

4.2.5.2 Alternative 2

Impacts anticipated under Alternative 2 would be the same as described under Alternative 1.

4.2.6 LAND USES AND VISUAL RESOURCES – CLRA

4.2.6.1 Alternative 1

On-post Land Use

The construction of new recreational cabins that is programmed for 2001 at the CLRA would improve the quality of the recreational experience for some users. The new buildings would replace the existing trailers, but would not alter land use. Any impacts to visitors during the construction of these cabins would be short-term and minimal. Furthermore, the existing lease between FSH and the U.S. Army Corps of Engineers is expected to be renewed, and there would be no future change or negative impacts resulting from land use.

Aesthetics

No negative impacts to aesthetics are anticipated as a result of Alternative 1.

4.2.6.2 Alternative 2

Impacts anticipated under Alternative 2 would be the same as described under Alternative 1.

4.2.7 SOCIOECONOMICS – CLRA

4.2.7.1 Alternative 1

The CLRA provides a number of small, positive impacts to the region through its recreation resources. According to facility managers, the area is generally at 72 to 79 percent capacity during the peak summer months. The facility is also a source of summer employment for local young people. The permanent staff at the CLRA is usually around 14, which represents a small, positive impact on the region. The projected decrease in military personnel at FSH under Alternative 1 is not considered to significantly impact the CLRA. No changes in activities at the CLRA for the foreseeable future would affect socioeconomics of the area.

4.2.7.2 Alternative 2

Impacts for Alternative 2 would be the same as described for Alternative 1. The anticipated increase of military personnel at FSH expected under this alternative would not, through the CLRA, create a measurable impact on the socioeconomics of the area.

4.2.8 CULTURAL RESOURCES – CLRA

4.2.8.1 Alternative 1

Archaeological Resources

There are no known archaeological resources at the CLRA that would be impacted by the existing mission of FSH. However, should there be any discoveries, FSH and the U.S. Army Corps of Engineers would be required to coordinate to protect the resource.

Architectural Resources

There are no known historic architectural resources within the CLRA lease area.

4.2.8.2 Alternative 2

Impacts Anticipated under Alternative 2 would be the same as described under Alternative 1.

4.2.9 UTILITIES/INFRASTRUCTURE – CLRA

4.2.9.1 Alternative 1

No changes are expected in the demand and distribution of electricity, propane gas, or water at the CLRA, and the local utility providing the service is not expected to have problems meeting CLRA requirements. Continued periodic sampling of potable water will address health standards requirements. No significant negative impacts respecting utilities are expected.

4.2.9.2 Alternative 2

Impacts anticipated under Alternative 2 would be the same as described under Alternative 1.

4.2.10 TRANSPORTATION AND CIRCULATION – CLRA

4.2.10.1 Alternative 1

Traffic at the CLRA is heaviest on weekends, but traffic congestion is not a problem. No negative impacts are foreseen under Alternative 1.

4.2.10.2 Alternative 2

Impacts anticipated under Alternative 2 would be the same as described under Alternative 1.

4.2.11 RECREATION – CLRA

4.2.11.1 Alternative 1

No impacts to recreation resources are anticipated under this alternative. The CLRA resources are deemed adequate to respond to the anticipated incremental military population changes if proper management of these resources is maintained.

4.2.11.2 Alternative 2

Impacts anticipated under Alternative 2 would be the same as described under Alternative 1.

4.2.12 HAZARDOUS MATERIALS/HAZARDOUS WASTE/SOLID WASTE

4.2.12.1 Alternative 1

Hazardous Materials Management

Under this alternative, a recreation billeting facility is planned for construction during FY 2001. A slight, temporary increase in the types and quantities of hazardous materials

may occur as part of planned construction and renovation activities. This increased usage, however, would be for the limited duration of a specific construction activity. Small, moderate quantities of these materials will be managed in accordance with applicable Army regulations and the FSH *Oil and Hazardous Substances Emergency Contingency Plan*, which includes the proper contacts and procedures to be followed in the event of a hazardous substance spill (USACE, 1998B).

A small increase in hazardous materials usage and storage associated with custodial maintenance and ancillary equipment (e.g., backup generators, HVAC equipment) of the proposed billeting facility would also occur, if built. All hazardous materials introduced by this alternative will be managed, stored, and used in accordance with applicable regulations and established installation protocols. Therefore, no significant adverse impacts associated with hazardous materials management, storage, or usage are expected under this alternative.

Hazardous Waste Management

No hazardous waste streams are regularly generated at the CLRA, and no new hazardous waste streams are expected to be generated at the CLRA under this alternative. Therefore, no changes or adverse impacts to hazardous waste management at the CLRA are expected under this alternative.

Medical and Biohazardous Waste

The CLRA is a recreational site. No regulated medical waste (RMW) streams are generated or stored at the CLRA lease area, and no new RMW streams are expected to be generated under this alternative. Therefore, no adverse impacts related to RMW management at the CLRA are expected under this alternative.

Low-level Radioactive Waste

The CLRA is a recreational site. No LLRW streams are generated or stored at the CLRA lease area, and no new LLRW streams are expected to be generated under this alternative. Therefore, no adverse impacts related to LLRW management at the CLRA are expected under this alternative.

Installation Restoration Program

No IRP sites are located at the CLRA. Therefore, no adverse impacts are expected under this alternative.

Solid Waste Management and Recycling Program

Under this alternative, solid waste generation is expected to slightly increase as a result of the construction and operation of the new recreation billeting facility. However, the increased volume is expected to be minimal, and solid waste management and disposal will continue to be accomplished through a private, licensed hauler, with disposal off-site at a private/municipal landfill. Therefore, no adverse impacts to solid waste management are expected under this alternative.

Wastewater

No significant changes in the generation and treatment of wastewater or disposal of treated effluent is expected at the CLRA under this alternative. Therefore, no adverse impacts regarding wastewater management at the CLRA are expected under this alternative.

4.2.12.2 Alternative 2

Impacts anticipated under Alternative 2 would be the same as described under Alternative 1.

4.3 ENVIRONMENTAL JUSTICE

Executive Order 12898, dated 11 February 1994, requires the Army to identify and address, as appropriate, the potential for disproportionately high adverse human health or environmental effects of their actions on minority or low-income populations.

The Army has not directly or indirectly used criteria, methods, or practices that discriminate on the basis of race, color, or national origin. The overall mission functions of FSH are based on requirements set by the national command structure to further national defense needs. This mission has been analyzed from an economic standpoint and potential social impacts considered. No disproportionately negative economic or social impact is anticipated to minority or low-income communities, and no human health impacts are believed to be associated with the ongoing FSH mission under Alternative 1 or Alternative 2.

4.4 CUMULATIVE IMPACTS

Cumulative impacts on environmental resources can result from the relationship of a proposed project or action to other past, present, and reasonably foreseeable future actions in the area. Cumulative impacts can result from minor, but collectively significant, actions undertaken over a period of time. In accordance with NEPA and the Council on Environmental Quality (CEQ) regulations, a discussion is required of cumulative impacts resulting from actions and projects that are proposed, under implementation, or reasonably anticipated to be implemented in the near future.

In this instance, since this EA assesses the continued operation of FSH, there is no single or specific action to evaluate in conjunction with other connected actions that are ongoing or planned for the reasonably foreseeable future. The ongoing functions of FSH, under either Alternative 1 or Alternative 2, including the numerous activities to be performed in support of the planned mission, do have environmental impacts. As outlined above, the various issues associated with FSH have been analyzed independently and found not to create any significant negative impacts to the human environment in the San Antonio area.

However, from a cumulative impacts perspective, two environmental resource areas involved with both Alternative 1 and Alternative 2 deserve additional discussion: air quality and water usage. Viewing the impacts of the FSH mission in relation to the surrounding area reveals additive or cumulative impacts, although they fall within reasonable tolerances and are therefore not considered significant.

Air emissions from FSH combine with local air emissions and degrade the atmosphere. However, the level of degradation is within regulatory limits, and the quantity of air

pollution attributable to FSH is relatively small and is considered reasonable. Vehicle traffic associated with FSH does add to congestion in the area and has a deleterious impact on air quality. However, traffic congestion is not considered to be a significant problem in San Antonio, and the impact attributable to FSH has not been identified as a problem. If the new, stricter EPA ozone standards are implemented, FSH would be expected to meet the revised requirements in conjunction with all others in this region.

Water usage by FSH from the Edwards Aquifer adds to the stress placed on that critical groundwater source by San Antonio and the surrounding communities. However, under either Alternative 1 or Alternative 2, the impact on the Aquifer by FSH would be within the water cap allotments established by the USFWS in response to threatened and endangered species concerns. The cumulative impacts from all users of the Edwards Aquifer have been identified and adjudicated and a mutual accommodation reached. In fact, under either mission alternative analyzed above, the actual anticipated Edwards Aquifer groundwater use by FSH would be less than FSH's authorized allotment.

A possible future military contingency that would cumulatively impact the region is mobilization for a national emergency. FSH is home to five major tenants (HQ MEDCOM, BAMC, AMEDDC&S, HQ 5th U.S. Army, and U.S. Army 5th Recruiting Brigade) and would serve as a mobilization point for troops and equipment.

During a mobilization, FSH normally handles between 100 and 2,500 persons over a 3-5 day period. During this operation, most of the administrative tasks, including medical screening and physical examinations associated with a mobilization, occur at FSH. Combat readiness and weapons familiarization training takes place at nearby Camp Bullis. Most heavy equipment, weapons, and vehicles are stored at Camp Bullis until moved to a designated shipping area, although significantly more vehicle traffic would use FSH.

Although mobilizations occur over 3-5 days, the movement of personnel through FSH may continue until full mobilization occurs. For example, FSH assisted in the mobilization of approximately 24,000 persons over the course of Operation Desert Storm. Personnel involved in a mobilization are typically housed in existing Army Component/Reserve Component Training Division billets on-post. Depending on the scale of a particular mobilization, operations normally scheduled to occupy these billets during a mobilization period may be housed in transient billets maintained by the Public Works Business Center. Normal operations could also be postponed or rescheduled during a mobilization until adequate space is available on-post. Personnel who are mobilized through FSH use Camp Bullis for mobilization-related training exercises. Camp Bullis is capable of accommodating up to 600 people in its housing facilities. If no overnight space for mobilization training is available at Camp Bullis, FSH personnel would be accommodated in medium-sized general purpose tents that are capable of housing 30 individuals each (Turner, 1997).

Cumulative impacts to FSH and the surrounding area associated with a mobilization would vary depending on the scale and extent of the mobilization. The primary resource impacted during any mobilization is utility consumption. However, increased levels of consumption during this period would be temporary, with the level of significance depending on the number of additional personnel on-post over time. Air quality at FSH would be impacted to some degree; however, the majority of equipment affiliated with a mobilization would be operated and stored at Camp Bullis. The operation of equipment

at Camp Bullis would contribute to an overall decline in air quality in the San Antonio area, depending on the scale and length of the operation. However, activities related to a mobilization are unlikely to result in San Antonio becoming a nonattainment area with respect to air quality. Groundwater usage during a mobilization would depend on the type and duration of the operation. The impact on the Edwards Aquifer would depend on conditions at the time, and any required mitigative resources would need to be determined then. No significant adverse impacts to cultural resources would be expected during a mobilization at FSH because billeting facilities to accommodate a mobilization already exist on-post. An increase could be expected in noise levels at FSH due to mobilization-related activities. However, this increase would be temporary and should not significantly impact FSH proper or the surrounding area. A mobilization is not expected to significantly impact other resources at FSH and in the ROI.

4.5 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Irreversible and irretrievable resource commitments are related to the use of nonrenewable resources and how this use may affect future generations. Irreversible effects usually result from the use or destruction of specific resources that cannot be replaced within a reasonable time. Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored as a result of the action. The following identified irreversible or irretrievable resource commitments are associated with the continued mission of FSH, under either Alternative 1 or Alternative 2:

- If FSH is to continue to operate, under either Alternative 1 or Alternative 2, an unavoidable and irretrievable commitment of resources would be involved in the provision of utilities and transportation fuels.

The following two resource areas have the potential for loss if proper procedures or priorities are not followed:

- The potential irreversible or irretrievable negative impacts upon threatened or endangered species from overuse of the Edwards Aquifer is a major concern. This concern, however, is believed to be allayed and future impacts controlled through the management actions taken pursuant to the USFWS Biological Opinion (Appendix B).
- Significant loss of cultural resources at FSH could occur, under either Alternative 1 or Alternative 2, if NRHP-eligible or listed resources (Historic Categories I, II, III) were demolished, neglected, or rehabilitated in such a manner that their historic characteristics are lost. If proper priorities are set, and existing regulations and protocols are followed, this potential for loss can be avoided.

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APPENDIX A

LIST OF ACRONYMS AND ABBREVIATIONS

LIST OF ACRONYMS AND ABBREVIATIONS

AACOG	Alamo Area Council of Governments
AAFES	Army Air Force Exchange Service
AAM	Annual Arithmetic Mean
ACHP	Advisory Council on Historic Preservation
ACOE	Army Corps of Engineers
AHPA	Archaeological and Historic Preservation Act
AIB/GIB	Applied Instruction Building/General Instruction Building
AMEDD	Army Medical Department
AMEDDC&S	Army Medical Department Center & School
APU	Auxiliary Power Unit
AQCR	Air Quality Control Region
AR	Army Regulation
ASIP	Army Stationing and Installation Program
AST	Aboveground Storage Tank
BAMC	Brooke Army Medical Center
BFI	Browning Ferris Industries
BMP	Best Management Practices
BRAC	Base Realignment and Closure
BOD	Biological Oxygen Demand
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CALS	Combat Assault Landing Strip
CAMS	Continuous Air Monitoring Station
CCD	Cost Comparison Document
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CLRA	Canyon Lake Recreation Area
CO	Carbon Monoxide
CRMP	Cultural Resources Management Plan
CPS	City Public Service
CVI	Capital Ventures Initiative

dB	Decibe
DoD	Department of Defense
DOL	Directorate of Logistics
DRMO	Defense Reutilization and Marketing Office
EA	Environmental Assessment
EIS	Environmental Impact Statement
ENRO	Environmental and Natural Resources Office
EO	Executive Order
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ESA	Endangered Species Act
FICON	Federal Interagency Committee on Noise
FOG	Fats, Oils, and Grease
FORSCOM	Forces Command
FSH	Fort Sam Houston
FY	Fiscal Year
gpd	gallons per day
gpy	gallons per year
HABS	Historic American Building Survey
HAER	Historic American Engineering Record
HH	Household
HQ	Headquarters
Hz	Hertz (cycles per second)
IRP	Installation Restoration Program
ISCP	Installation Spill Contingency Plan
ITR	Information, Travel, and Reservations
kwh	kilowatt-hours
kgal	thousand gallons
L_{dn}	Day-Night Average Noise Level
MARS	Military Affiliate Radio System
Mbtu/hr	Million British Thermal Units per hour
MEDCOM	US Army Medical Command
MED LOG	Medical Logistics
MHPI	Military Housing Privatization Initiative
$\mu g/m^3$	micrograms per cubic meter
mg/L	milligrams per liter
MHHI	Median Household Income
MOU	Memorandum of Understanding

MSA	Metropolitan Statistical Area
msl	mean sea level
MTR	Military Training Route
MWR	Morale, Welfare, and Recreation
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NFHH	Nonfamily Household
NHLD	National Historic Landmark District
NHPA	National Historic Preservation Act
NOI	Notice Of Intent
NOx	Nitrogen Oxides
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRHP	National Register of Historic Places
OMA	Operations and Maintenance Army
O&M	Operations and Maintenance
ORC	Outdoor Recreation Center
P3	Pollution Prevention Plan
PA	Public Agreement or Programmatic Agreement
PAO	Public Affairs Office
PCI	Per Capita Income
POL	Petroleum Oil Lubricant
POTW	Publicly-owned treatment works
ppm	parts per million
PPOA	Pollution Prevention Opportunity Assessment
PSD	Prevention of significant deterioration
PWBC	Public Works Business Center
RCI	Residential Communities Initiative
RCRA	Resource Conservation and Recovery Act
RLBC	Readiness and Logistics Business Center
ROI	Region of Influence
RSC	Regional Support Command
SARA	Superfund Amendments and Reauthorization Act
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SPCC/ISCP	Spill Prevention, Control, and Countermeasures Plan & Installation

SWPPP	Stormwater Pollution Prevention Plan
TDS	total dissolved solids
TEC	The Environmental Company, Inc.
TNRCC	Texas Natural Resource Conservation Commission
TPDES	Texas Pollutant Discharge Elimination System
TSS	total suspended solids
USACE	US Army Corps of Engineers
USDA	US Department of Agriculture
USFWS	US Fish and Wildlife Service
UST	underground storage tank
VOC	volatile organic compound
WWTP	Wastewater Treatment Plant

APPENDIX B

U.S. DEPARTMENT OF THE INTERIOR

U.S. FISH AND WILDLIFE SERVICE

BIOLOGICAL OPINION
2-15-98-F-759

DEPARTMENT OF THE AIR FORCE
AIR EDUCATION AND TRAINING COMMAND

24 JAN 2000

MEMORANDUM FOR 12 FTW/CC 37 TRW/CC SA-ALC/CC MCCS-Z

FROM: HQ AETC/CE
266 F Street W
Randolph AFB TX 78150-4319

SUBJECT: US Fish and Wildlife Service (FWS) Biological Opinion (BO)

1. The BO for all DoD San Antonio military installations which pump groundwater from the Edwards Aquifer was signed on 5 Nov (Atch 1). As a result, total pumping from the aquifer for these bases is limited to 11,830 ac-ft/yr in the near term and 10,515 ac-ft/yr in CY02. Each base has a percentage of the total amount of water, based on the pumpage information provided by the individual bases in the developmental stages of the BO. This breakout is found at Atch 2. Please note that the near-term pumpage cap is very close to the amount of water pumped by all the DoD San Antonio military installations in 1995.

2. The Military Water Working Group (MWWG), chaired by HQ AETC/CE and comprised of members from your bases, is the vehicle for managing the BO. A subcommittee of the MWWG is currently being established to develop the Operations Plan to implement the BO. Each base will be responsible for development of their internal procedures and drought management plans. It is important that your base personnel keep a close eye on pumpage to stay within individual base limits for non-drought and drought conditions. Additionally, we need to continue to implement measures whenever feasible to reduce dependence on the Edwards Aquifer without impacting mission requirements.

3. Should you require additional information, please call me at 652-6326 or have your staff contact our POC, Ms Janie Gunter, HQ AETC/CEOE, 652-2774, e-mail: barbara.gunter@randolph.af.mil.

V/R

RUSSELL L. GILBERT
Colonel, USAF
The Civil Engineer

Attachments:
1. Biological Opinion
2. Water and Cost Allocation by Installation

cc: 37 SPTG/CC
12 SPTG/CC
76 SPTG/CC
MCCS-B
37 CES/CC
12 CES/CC
76 CES/CC
MCGA-PW

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Austin Ecological Services Office
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NOV 17 1999

David M. Cannan, Brigadier General, USAF
Department of the Air Force
Air Education and Training Command
HQ AETC/CE
266 F Street West
Randolph AFB, TX 78150-4321

Dear Gen. Cannan:

Due to an oversight on our part, half of a paragraph was left out of the Biological Opinion (2-15-98-F-759) issued to you on November 5, 1999. This error occurred during last minute formatting to insert the tables and figures. We appreciate DoD staff bringing this omission to our attention. We reinserted the missing text and re-printed the Biological Opinion with a new Table of Contents. The enclosed Biological Opinion is the corrected version and replaces that originally sent to you.

We apologize for the oversite. It has been a pleasure working with you.

Sincerely,

William Seawell

for

David C. Frederick
Supervisor

United States Department of the Interior

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Department of the Air Force
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266 F Street West
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Dear Gen. Cannan:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion based on our review of the effects of Edwards aquifer withdrawals incidental to the combined ongoing activities and projected mission increases anticipated at four Department of Defense (DOD) military installations (Fort Sam Houston, Lackland Air Force Base (AFB), Kelly AFB, and Randolph AFB), located in San Antonio, Bexar County, Texas. Species evaluated for effects are the fountain darter (*Etheostoma fonticola*), Texas wild-rice (*Zizania texana*), San Marcos salamander (*Eurycea nana*), Texas blind salamander (*Typhlomolge rathbuni*), San Marcos gambusia (*Gambusia georgei*), Comal Springs riffle beetle (*Heterelmis comalensis*), Comal Springs dryopid beetle (*Stygoparnus comalensis*), and Peck's cave amphipod (*Stygobromus pecki*) and designated critical habitat for the fountain darter, Texas wild-rice, San Marcos salamander, and San Marcos gambusia in accordance with section 7 of the Endangered Species Act of 1973 (ESA), as amended, (16 U.S.C. 1531 et seq.).

Brooks AFB was originally being considered under this consultation. However, DOD decided to remove it from the consultation because Brooks AFB does not pump its own water, but rather, it buys it from a San Antonio water purveyor, San Antonio Water System (SAWS). Camp Stanley and Camp Bullis were also not included because they do not withdraw water from the Edwards Aquifer. Your February 12, 1998 request for formal consultation was received on February 18, 1998. Kelly AFB was not originally included in your request because it had already undergone consultation and a biological opinion issued on June 26,1997 (Consultation # 2-15-97-F-039). This biological opinion (2-15-98-F-759) represents an amendment to the Kelly AFB biological opinion and a new biological opinion for the other three military installations, Lackland AFB, Fort Sam Houston, and Randolph AFB.

This biological opinion is based on information provided in your February 1998 biological assessment, supplemental information provided by DOD, information in our files, discussions with involved parties, and other information available to us. A complete administrative record of this consultation is on file in the Austin Ecological Services Field Office.

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Consultation History

DOD contacted the Service for assistance in fulfilling their endangered species responsibilities in a manner that would acknowledge and compensate for their activities that adversely impact the quantity and quality of Edwards aquifer water resources by initiating informal consultation with the Service on September 27, 1996, during a meeting to discuss a Programmatic Environmental Impact Statement (PEIS) for the disposal of Kelly AFB. Other topics discussed included ongoing activities and proposed mission changes that would result in potential increases in water use by the five DOD installations (Lackland AFB, Fort Sam Houston, Randolph AFB, Kelly AFB, and Brooks AFB) in San Antonio, efforts to reduce their withdrawal from the Edwards aquifer and other alternative sources. It was agreed at that time that the disposal of Kelly AFB would be handled separately because of time constraints and the remaining military installations, including the portion of Kelly scheduled for realignment to Lackland, would be addressed in a separate analysis under Section 7 of the ESA. However, to simplify the consultation and allow Lackland and Kelly AFB to share water we decided to include the portion being realigned to Lackland in the Kelly AFB disposal consultation. Other joint meetings with base representatives during the development of the Kelly AFB PEIS where the larger four base (Lackland AFB, Fort Sam Houston, Randolph AFB, and Brooks AFB) consultation was discussed were November 18, 1996 and November 24, 1996 and February 7, 1997. On June 26, 1997 a final biological opinion was issued to Kelly AFB (Cons# 2-15-97-F-039). On June 24, 1997 our office met with Gen. Cannan and other representatives to discuss format and information needed to formulate a biological assessment (BA) on the remaining four base consultation. The BA was to analyze both the ongoing activities and projected mission increases at the five bases. The ongoing activities included activities currently being conducted at Fort Sam Houston and at Lackland, Randolph, and Brooks AFBs. For the purpose of the BA, DOD assumed that Kelly AFB military water consumption would remain constant through Fiscal year 2001, as agreed to in the biological opinion issued to Kelly AFB (Cons.# 2-15-97-F-039). Therefore, for water withdrawal effects Kelly AFB was not included, and only four bases (Lackland AFB, Fort Sam Houston, Randolph AFB, and Brooks AFB) were to be included as part of the consultation and biological opinion.

On February 12, 1998, DOD transmitted to the Service three copies of the BA and request for formal consultation. The Service received their request and BAs on February 18, 1998. The BA was reviewed and a phone request was made by our office, on February 24, 1998, to provide us with other reviewer's comments. The Service sent written acknowledgment of receipt of DOD's February 12, 1998 request for formal consultation on March 23, 1998.

A meeting was held on April 7, 1998 with Gen. Cannan and representatives from the four bases. DOD and the Service recognized there would be significant practical constraints in solving these complicated resource issues because of the logistical constraints of time needed to put effective reduction measures in place and the complicated nature of many regional users contributing to the decline of the resource. We also agreed that a fair and equitable approach was necessary for all users. At that time the Service requested drought management plans for each base and it was agreed the Service would begin a draft biological opinion and the

consultation period was scheduled to end July 3, 1998. On June 3, 1998, DOD provided the drought plans and requested further information on the Edwards aquifer conservation fund.

On June 29,1998, in a telephone conversation with Dan Soto, the Service and DOD agreed to a 60 day extension because new information had become available regarding the proposed permits to be issued by the Edwards Aquifer Authority (EAA). The new date for completion was set for August 31, 1998.

On July 7, 1998, the Service submitted the draft opinion for DOD review. After review DOD requested a conference with Service representatives to discuss the draft biological opinion. Alisa Shull and Mary Orms attended the meeting at Randolph AFB on July 27, 1998. Discussion points included ways to minimize take, water withdrawal reduction figures, calculations used to determine the reduction figures, nondiscretionary vs. discretionary use, and the possibility of Kelly AFB reinitiating or amending the biological opinion and being included in this biological opinion and dropping Brooks AFB out of the consultation. DOD needed time to gather further information on issues discussed and make a decision on Kelly AFB and Brooks AFB. Our next meeting was tentatively scheduled for August 17, 1998.

On August 4, 1998, in a telephone conversation, and a follow-up letter on August 18, 1998, DOD requested a 90-day extension on the consultation to better formulate their response to the draft biological opinion. At that time they also requested that Brooks AFB be removed from the consultation to alleviate the irregularities in the draft biological opinion due to the fact that Brooks does not directly pump from the aquifer but rather purchases its water from SAWS. The extension was set to November 31, 1998.

On November 19, 1998, in a telephone conversation the Service and DOD mutually agreed to extend the consultation to January 31, 1999 to give each of us sufficient time to discuss and resolve the details in this complex issue. On November 24, 1998, DOD presented comments and proposed changes to the draft biological opinion. The response was a DOD consensus position that had been coordinated with the leadership of each installation.

On January 7, 1999, a meeting was held to discuss supplemental information needed to resolve issues on what the Service and DOD considered to be nondiscretionary and discretionary uses and limits and trigger levels for military Drought Management Plans. In a letter dated January 26, 1999, DOD stated they were still in the process of compiling information from each installation and obtaining the necessary coordination for submitting a consolidated response and requested an extension of 60 days to March 31, 1999, to which the Service agreed.

On March 19, 1999, DOD provided the supplemental information requested. On March 22, 1999, in a telephone conversation between Mary Orms and Dan Soto and Marion Erwin the Service explained that it would need time to review the material sent, and that it would be difficult to resolve some major issues and complete consultation by March 31, 1999. Therefore, the Service was not requesting another extension but the Service was going to take the necessary time to complete an adequate review of the information provided. On March 25,

1999, in a telephone conversation, Mary Orms and Pat Connor discussed the supplemental information with Dan Soto and Marion Erwin from DOD. During the same phone conversation DOD advised the Service that Kelly AFB would be part of the consultation. We stated we would need to recalculate their figures, and the Service would need adequate time to review the proposed reduction figures, multipliers being proposed in the Drought Management Plan, and a new request from DOD that the biological opinion state that this consultation would culminate in the issuance of the biological opinion and would also meet the requirements to consult with the Service under both Sections 7(a)1 and 7(a)2.

On April 13, 1999, in a conference call between Marion Erwin, Col. Sullivan, Dan Soto, DOD, and Service representatives, Alisa Shull, Pat Connor, and Mary Orms, we further discussed the issues in DOD's supplemental information provided March 19, 1999. A conference call was held April 22, 1999 with Gen. Cannan, Marion Erwin, and Col. Stuebben, DOD, and Mary Orms and Alisa Shull of the Service. We agreed that additional information from EAA was needed to help determine DOD's percent of overall pumping. We also agreed Lackland AFB's maximum figure had not been corrected in the EAA database. Gen. Cannan agreed to contact Col. Sullivan and provide the Service with additional information in the form of a written example of how much reduction the proposed drought management plan would be providing and the effects multipliers would have to help us understand whether the multipliers were really accomplishing significant reductions that would minimize impacts to the species and help them survive low flows during drought. We also discussed the need to recalculate Kelly AFB's percent with the new database figures and also recalculate their share of take minimization efforts. We informed them that the Service had a meeting scheduled with Steve Walthour of EAA on April 26, 1999 to discuss the database and needed information. We mutually agreed to continue working on the consultation until that information was gathered and DOD had time to provide us with further supplemental information that would help the Service better evaluate what the multipliers proposed in the drought management plan were accomplishing.

On April 26, 1999, Alisa Shull, Mary Orms, and Pat Connor met with Steve Walthour of EAA. The new database was forwarded to our office on May 6, 1999. The additional information from Col. Sullivan was received on May 12, 1999. On June 22, 1999, the Service provided DOD a revised draft biological opinion for their review. On August 30, 1999, DOD provided us with official comments on the revised draft. On October 22, 1999, a conference call was held between Alisa Shull and Mary Orms of the Service, and Marion Erwin and Lt. Col. Borland of DOD to discuss the Drought Management Plan Stage V trigger levels, Fort Sam Houston's totals, the domestic and livestock number and a few wording changes. DOD revised Tables 2, 5, and 6 and provided them to the Service on October 25 and 26th. On October 26th another conference call was held with DOD representatives, Col. Sullivan, Marion Erwin, Dan Soto and Lt. Col. Borland and Mary Orms and Alisa Shull of the Service. Col. Sullivan was unable to attend the October 22nd conference call, therefore additional discussion regarding the Drought Management Plan was held on October 26th. Different methods of calculating the Stage V installations total maximum monthly withdrawal

amount and multiplier were discussed in the 10/26 conference call between Marion Erwin, Lt. Col. Borland, Dan Soto, Col. Sullivan and Alisa Shull and Mary Orms. Both parties agreed on a multiplier of 1.185 and a total of 1,002 ac-ft withdrawal amount. However, the inclusion of the San Marcos 80 cfs trigger level was still of concern to DOD. Their concern was that a trigger level of 80 cfs at San Marcos in Stage V could possibly trigger the installations to enter Stage V earlier than the rest of the region and skip some stages. DOD and the Service mutually agreed to look further at the previous data and discuss it within a day or two. In a telephone call on October 27th, between Marion Erwin and Mary Orms, progress on Stage V and the issue of the need for re-consultation if EAA was to have a regional permit in place at the conclusion of DOD's 5-year consultation were discussed. In a telephone conversation on October 29th, Alisa Shull and Marion Erwin discussed including the San Marcos trigger level of 80 cfs at all stages. This would allow the installations to progressively work down toward the Stage V level and avoid skipping a stage.

On November 1st in a telephone conversation between Mary Orms and Marion Erwin an oversight in the EAA database (that was brought to the Service's attention on October 29th) was discussed. It was noted that 19 pumpers, a majority irrigators, had not been given a proposed permit amount in one of the columns of the database. Steve Walthour explained that for one reason or another there had been a problem with the information submitted to EAA, therefore, a permit amount was not calculated pending further review. The result was that the amount we had been using as total average historic use was lower than it should have been. This total was used to calculate DOD's percentage and withdrawal amounts for the purpose of this biological opinion. DOD and the Service agreed that verification of these numbers and re-calculation of DOD's percentage and withdrawal amounts would cause a lengthy delay. Therefore, since finalization of this biological opinion was to occur in the next few days, both parties agreed the numbers would remain unchanged for the purpose of this DOD biological opinion.

On November 2nd in a telephone conversation between Marion Erwin and Mary Orms, Ms. Erwin conveyed that Col. Sullivan was in agreement with the inclusion of the San Marcos trigger level but Gen. Cannan and other base representatives still needed to be briefed. On November 3rd Marion Erwin called Mary Orms and updated her on the progress. A draft copy of Table 10, DOD Drought Management Plan of Staged Reductions was faxed to DOD to assist them in the briefing. She also explained that the laundry facility on Lackland had already been closed and conversion of the cooling towers were already in progress. DOD also anticipated that Fort Sam Houston would be online for reuse water by April 2000 and Lackland AFB sometime in calendar year 2000. In another telephone conversation later that same morning with Col. Borland, Marion Erwin and Mary Orms and Pat Connor, DOD presented us with a revised Table 10. The revision did not include changing the trigger levels but rather rewording to make the table more easily understandable for the installations to implement. The Service and DOD were in agreement on the changes. Later that afternoon DOD provided the Service with a letter from Brigadier General David Cannan that DOD installations in San Antonio will be able to adequately perform their missions under the

provisions of the current draft biological opinion with the attached mutually agreed upon minor changes to Table 10. Therefore, this represents the final biological opinion for DOD on this topic.

BIOLOGICAL OPINION

Description of the Proposed Action

Water Use

The four installations, Fort Sam Houston, Kelly, Lackland, and Randolph AFBs are located throughout the city of San Antonio, Bexar County, Texas (Figure 1). Full descriptions of each base's locations, missions and proposed actions are described in the February 1998 Biological Assessment titled *"The Effect of Water Draw on the Edwards Aquifer by the Department of Defense Installations in the San Antonio Area"* and supplemental information provided by DOD. The actions proposed for the installations that were discussed in the BA have either been or will be reviewed in separate NEPA documents, but are considered part of overall mission activities for the purposes of this consultation.

The principal conclusion of the DOD BA was that when aquifer levels were low because of drought or near-drought conditions, aquifer withdrawals specifically associated with the current and proposed actions, as a component of total withdrawals by all users throughout the Edwards aquifer region, may affect threatened and endangered species. The Service concurred with the "may affect" finding. For the purposes of this consultation the action area includes the Edwards aquifer, the San Marcos and Comal aquatic systems (including their springs, lakes and rivers), and caves associated with the aquifer that are connected to, dependent on and an integral part of the larger Edwards aquifer ecosystem. When referring to the Edwards aquifer in this document, we mean the San Antonio segment of the Edwards (Balcones Fault Zone) aquifer, which extends from Brackettville (Kinney Co.) to near Kyle (Hays Co.).

Water use associated with Kelly AFB was handled in Consultation # 2-15-97-F-039, but DOD has decided to amend the consultation and reconsider Kelly AFB water withdrawal in this current consultation (# 2-15-98-F-759). In the original 5 ½ year (June 1997- December 2002) Kelly AFB consultation, DOD was responsible for apportioning the total water use figures issued under that biological opinion between the various components of the realigned areas, that is between Greater Kelly Development Corporation (GKDC) and Lackland AFB. GKDC was also made responsible for obtaining the necessary Endangered Species Act (ESA) permits for any continued Edwards aquifer water use beyond the 5 ½ year time frame. This four base consultation covers the portions of Kelly AFB realigned to Lackland and the other three military installations from November 1999 to December 2003 (4 years). The amount of time

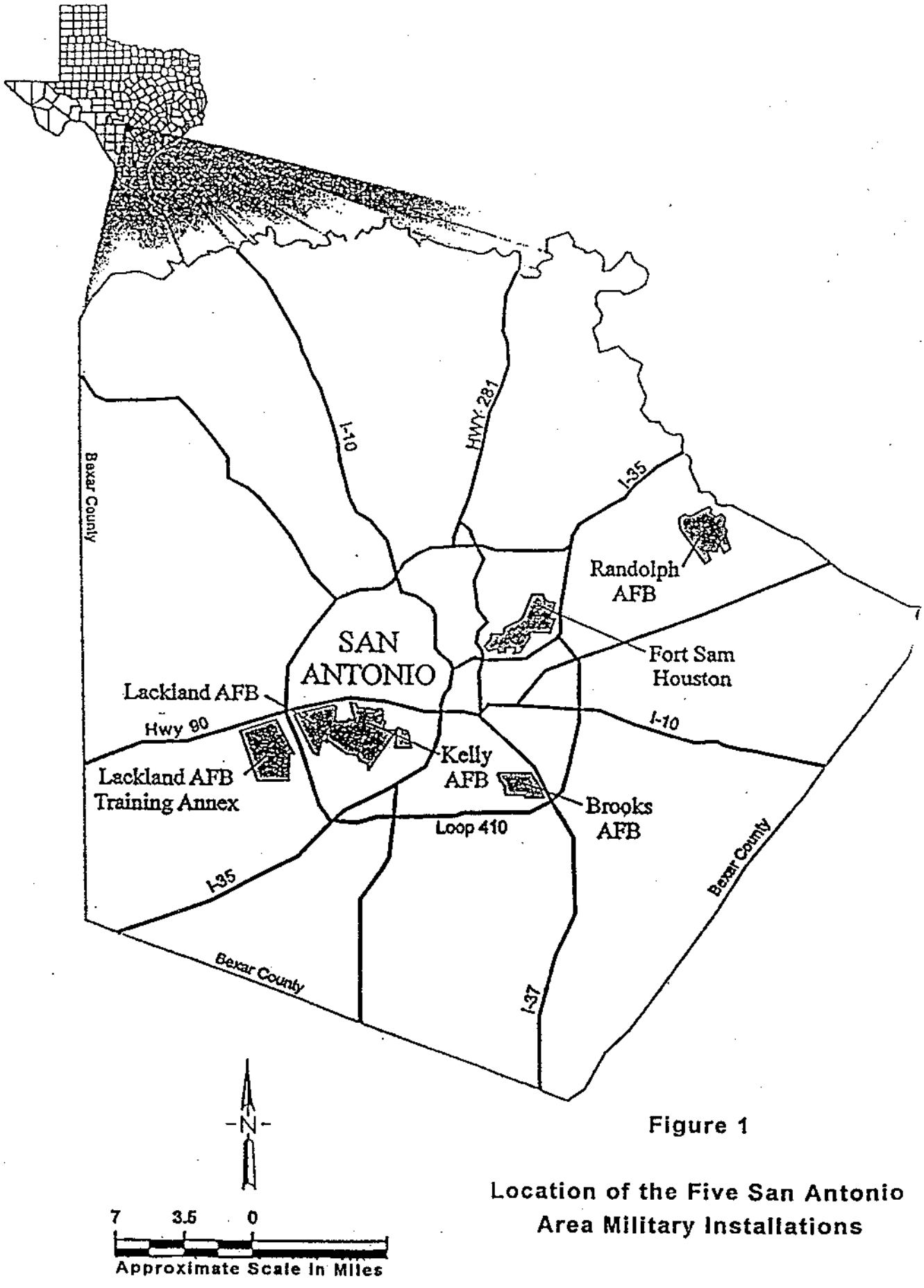


Figure 1

Location of the Five San Antonio Area Military Installations

that GKDC's water use will be covered under a DOD biological opinion will remain December 2002. To avoid a lapse in coverage for incidental take under the ESA, GKDC should begin working with the Service to prepare their permit application well before the end of the 5 ½ year time frame as agreed to in the original Kelly AFB consultation.

The four installations are continually subject to actions that affect water use, such as base closures, remodeling, renovation, construction of new facilities to support existing installation activities, or additional or expanded missions. Each of the four military installations covered by this biological opinion directly withdraw water from the Edwards aquifer and have their own unique specific mission. These missions include flying training, ground-based training, medical training, flying operations and aircraft maintenance.

The installations are like small municipalities, and as such, use water for varied purposes similar to the uses of other municipalities. Mission(s) could be added or decreased and could differ from existing installation(s) activities and require a similar increase or decrease in water than currently used. Some of these uses are discretionary, while others are nondiscretionary. Nondiscretionary water uses are necessary to accomplish the missions and support the health and safety of resident employees and their families living on the military installations that pump water directly from the Edwards aquifer. Discretionary water uses on military installations that pump water directly from the Edwards aquifer include water used for irrigation; watering landscaping around administrative buildings and military housing areas, golf courses, parade grounds and similar areas; ornamental fountains; car washing; and maintaining levels in swimming pools used exclusively for recreation and not training.

Table 1 includes individual and total combined water use by the four installations as reported by DOD to EAA for the 21 year historical period from 1973 to 1993. The total of the maximum annual water used by the four bases, after EAA technical review, was 15,124.348 ac-ft/yr. The historic 21-year average, after EAA technical review, for the four bases was 12,264.638 ac-ft/yr.

The total of average historic uses for all pumpers with historic use in 3 or more years (eligible for an EAA permit) after EAA technical review was calculated at 459,388.281 ac-ft/yr. Three applicants that had less than three years historical use were not included in the average historical use numbers provided to us by EAA, but EAA indicated that they would likely be given a permit. Their total, according to the numbers provided by EAA, was 7,147.594 ac-ft/yr making the total of average historic uses for all pumpers (eligible for an EAA permit) 466,535.875 ac-ft/yr.

This total excludes certain domestic and livestock users that are exempt from EAA permit requirements. We are assuming this amount is $<13,000$ ac-ft/yr (Steve Walthour, EAA, pers. comm., Brown et. al 1992). If this figure proves to be more than 20,000 ac-ft/yr, then DOD may need to reconsult.

Table 1. Historical 21-year average for four military installations

EAA Docket Number	Military Installation	Maximum Claimed (ac-ft/yr)	Historical 21-Year Avg (ac-ft/yr)	Maximum Claimed (ac-ft/yr) after EAA Technical Review	Historic 21-year Average (ac-ft/yr) after Technical Review
BE00151	Lackland AFB	5,327.202	4,144.238	4,794.482	3,729.814
BE00178	Fort Sam Houston	4,735.714	4,099.380	4,262.142	3,689.442
BE00239	Kelly AFB	4,724.948	3,905.163	4,252.453	3,514.647
BE00180	Randolph AFB	2,016.968	1,478.594	1,815.271	1,330.735
Total		16,804.832	13,627.375	15,124.348	12,264.638

Note: In the case of DOD military bases "EAA Technical Review" resulted in 10% reduction across-the-board for water assumed lost in distribution due to line leakage and similar losses.

We believe 20,000 ac-ft/yr is a significant number, however, we are willing to accept that number as a trigger for re-evaluating the need for DOD to reconsult because DOD's biological opinion only covers four years. Dividing the combined total of average historic uses of the four installations (12,264.638) by the total of average historic uses of all pumpers from the Edwards aquifer (eligible for an EAA permit) (466,535.875) gives the four bases' historic percentage of total water withdrawal. The combined percentage for the four bases is 2.6% (0.0262887).

The approximate recent annual water usage (1998) for each of the four military installations that pump water directly from the Edwards aquifer and activities and amounts that are considered nondiscretionary and discretionary are outlined in Tables 2-5 provided by DOD to the Service in their response dated March 19, 1999 and revised on October 25, 1999. Table 6 summarizes recent discretionary and non-discretionary Edwards aquifer water use in 1998 and projected future year 2001 Edwards aquifer water usage data for the four military installations that pump water directly from the Edwards aquifer. The 1998 percentage of discretionary water use at the installations ranges from 6.7% at Kelly AFB to 25% at Fort Sam Houston. Water savings have been realized through implementation of large-scale wastewater reuse systems at Randolph and Kelly and repairs and modifications to the installations' water distribution systems. Kelly and Randolph currently use recycled Edwards aquifer water for irrigating their golf courses and use relatively lower percentages of discretionary water from the Edwards aquifer, 6.7% and 12.4% respectively. The other two installations, Fort Sam Houston and Lackland have a higher percentage of their discretionary water use coming from the Edwards aquifer, 25% and 18.7% respectively. These installations currently use water from the Edwards aquifer to irrigate their golf courses. Both Fort Sam Houston and Lackland are planning to further decrease their dependence on the Edwards Aquifer by using recycled water for irrigating their golf courses as well as for other uses. Both installations have already signed contracts with San Antonio Water System (SAWS) reserving options to procure 1,294.7

TABLE 2. Fort Sam Houston Current and Projected (Year 2001) Edwards Aquifer Annual Water Usage (Approximate)

Water Use		Volume (Acre-Feet/Year)	Current Source	Future Source (YR 2001)	Discretionary
Domestic	Military Family Housing	379.2	Edwards Aquifer	Edwards Aquifer	No
	Barracks, Dorms, Food Service Operations, Office & Administration Areas	1078.3	Edwards Aquifer	Edwards Aquifer	No
Industrial	Medical Center	354.7	Edwards Aquifer	Edwards Aquifer	No
	Cooling Towers	44.3	Edwards Aquifer	Edwards Aquifer	No
		177.5	Edwards Aquifer	Reuse Water	No
		29.8	Edwards Aquifer	Convert to Air Cooled System	No
Other	Laundry	47.3	Edwards Aquifer	Close Plant in FY99	No
	Wash Racks	0.5	Edwards Aquifer	Edwards Aquifer	Yes
	Car Wash	0.7	Edwards Aquifer	Reuse Water	Yes
Swimming Pools	Aquatic Center (Military Training)	0.3	Edwards Aquifer	Edwards Aquifer	No
	Fitness Center	0.1	Edwards Aquifer	Edwards Aquifer	Yes
Irrigation	Golf Course	402.1	Edwards Aquifer	Reuse Water	Yes
	Athletic Fields	85.2	Edwards Aquifer	Reuse Water	Yes
	Office Complex	43.1	Edwards Aquifer	Edwards Aquifer	Yes
		16.9	Edwards Aquifer	Reuse Water	Yes
	Residential	69.4	Edwards Aquifer	Edwards Aquifer	Yes
	VA Cemetery	91.3	Edwards Aquifer	Reuse Water	Yes
TOTAL DISCRETIONARY (1998):		**709.3 acre-feet /year**			
TOTAL DISCRETIONARY PROPOSED FOR REUSE WATER		596.2 acre-feet/year			
TOTAL NONDISCRETIONARY (1998):		**2111.4 acre-feet/year**			
NONDISCRETIONARY PROPOSED FOR REUSE WATER		177.5 acre-feet/year			
TOTAL USAGE (1998):		**2820.7 acre-feet/year**			
TOTAL PROPOSED FOR FUTURE REUSE WATER		773.7 acre-feet/year			

TABLE 3. Kelly AFB Current and Projected Edwards Aquifer Annual Water Usage (Approximate)

Water Use		Volume (Acre-Feet/Year)	Current Source	Future Source	Discretionary
Domestic	Military Family Housing, Dorms, Billeting, Food Service, Offices, Medical Facilities	885.2	Edwards Aquifer	Edwards Aquifer	No
Industrial	Cooling Towers	370.5	Edwards Aquifer	Edwards Aquifer	No
	Industrial Processes	1132	Edwards Aquifer	Edwards Aquifer	No
Other	Car Washing	1.4	Edwards Aquifer	Edwards Aquifer	Yes
Swimming Pools	Three	4.2	Edwards Aquifer	Edwards Aquifer	Yes
Irrigation	Military Family Housing	50	Edwards Aquifer	Edwards Aquifer	Yes
	Main Base	114.6	Edwards Aquifer	Edwards Aquifer	Yes
TOTAL DISCRETIONARY (1998): TOTAL DISCRETIONARY PROPOSED FOR REUSE WATER			**170.2 acre-feet /year** 0 acre-feet/year		
TOTAL NONDISCRETIONARY (1998): NONDISCRETIONARY PROPOSED FOR REUSE WATER			**2387.7 acre-feet/year** 0 acre-feet/year		
TOTAL USAGE (1998): TOTAL PROPOSED FOR FUTURE REUSE WATER			**2557.9 acre-feet/year** 0 acre-feet/year		

TABLE 4. Lackland AFB Current and Projected (Year 2001) Edwards Aquifer Annual Water Usage (Approximate)

Water Use		Volume (Acre-Feet/Year)	Current Source	Future Source (FY 2001)	Discretionary
Domestic	Military Family Housing, Dorms, Billeting, Food Service, Offices	1515.6	Edwards Aquifer	Edwards Aquifer	No
Industrial	Total Energy Plant Cooling Towers	92	Edwards Aquifer	Reuse Water	No
	Other Cooling Towers	454.0	Edwards Aquifer	Edwards Aquifer	No
	Medical Center	233.0	Edwards Aquifer	Edwards Aquifer	No
Other	Car Washing	0.6	Edwards Aquifer	Edwards Aquifer	Yes
Swimming Pools	Confidence Course, Fitness Center, Medical Center Therapy Pools	0.6	Edwards Aquifer	Edwards Aquifer	No
	Other	6.8	Edwards Aquifer	Edwards Aquifer	Yes
Irrigation	Golf Course	276	Edwards Aquifer	Reuse Water	Yes
	Parade Field	153	Edwards Aquifer	Resue Water	Yes
	Athletic Fields	93.0	Edwards Aquifer	Edwards Aquifer	Yes
TOTAL DISCRETIONARY (1998):			**529.4 acre-feet /year**		
TOTAL DISCRETIONARY PROPOSED FOR REUSE WATER			429.0 acre-feet/year		
TOTAL NONDISCRETIONARY (1998):			**2295.2 acre-feet/year**		
NONDISCRETIONARY PROPOSED FOR REUSE WATER			92.0 acre-feet/year		
TOTAL USAGE (1998):			**2824.6 acre-feet/year**		
TOTAL PROPOSED FOR FUTURE REUSE WATER			521.0 acre-feet/year		

TABLE 5. Randolph AFB Current and Projected Edwards Aquifer Annual Water Usage (Approximate)

Water Use		Volume (Acre-Feet/Year)	Current Source	Future Source	Discretionary
Domestic/Industrial	Military Family Housing, Dorms, Billeting, Food Service, Offices Cooling Towers Medical Clinic	1010.8	Edwards Aquifer	Edwards Aquifer	No
Industrial	Cooling Towers	65.5	Edwards Aquifer	Edwards Aquifer	No
Swimming Pools	One (Military Training)	0.2	Edwards Aquifer	Edwards Aquifer	No
	Two	0.6	Edwards Aquifer	Edwards Aquifer	Yes
Other	Car Washing	0.8	Edwards Aquifer	Edwards Aquifer	Yes
Irrigation	Military Family Housing	100.9	Edwards Aquifer	Edwards Aquifer	Yes
	Athletic Fields	11.4	Edwards Aquifer	Edwards Aquifer	No
	Main Base	51.5	Edwards Aquifer	Edwards Aquifer	Yes
TOTAL DISCRETIONARY (1998):			**153.8 acre-feet /year**		
TOTAL DISCRETIONARY PROPOSED FOR REUSE WATER			0 acre-feet/year		
TOTAL NONDISCRETIONARY (1998):			**1087.9 acre-feet/year**		
NONDISCRETIONARY PROPOSED FOR REUSE WATER			0 acre-feet/year		
TOTAL USAGE (1998):			**1241.7 acre-feet/year**		
TOTAL PROPOSED FOR FUTURE REUSE WATER			0 acre-feet/year		

TABLE 6. Percentages of Discretionary Water Usage

		Fort Sam Houston	Kelly AFB	Lackland AFB	Randolph AFB	All Installations
Current (1998)	Discretionary (Acre-Feet/Year)	709.3	170.2	529.4	153.8	1562.7
	Non-Discretionary (Acre-Feet/Year)	2111.4	2387.7	2295.2	1087.9	7882.2
	Total (Acre-Feet/Year)	2820.7	2557.9	2824.6	1241.7	9444.9
	Percent Discretionary	25%	6.7%	18.7%	12.4%	16.5%
Future	Discretionary (Acre-Feet/Year)	113.1	170.2	100.4	153.8	537.5
	Non-Discretionary (Acre-Feet/Year)	1856.8*	2387.7	2203.2	1087.9	7535.6
	Total (Acre-Feet/Year)	1969.9*	2557.9	2303.6	1241.7	8073.1
	Percent Discretionary	5.7%	6.7%	4.4%	12.4%	6.7%

NOTE: This table shows Edwards Aquifer water usage only.
* Totals accounts for 29.8 ac-ft/yr for the cooling tower conversion to an air-cooled system and 47.3 ac-ft/yr for the laundry facility that was closed in FY99. The total of these two (77.1 ac-ft/yr) will not be Edwards aquifer water nor reuse water.

ac-ft per year of recycled water. It is anticipated that Fort Sam Houston will be on reuse water by April 2000 and Lackland AFB by sometime in calendar year 2000. Upon implementation of the recycled water plans and conservation projects, Fort Sam Houston and Lackland will use substantially less water from the Edwards aquifer than they used in 1998. Their percentages of discretionary water use coming from the Edwards are projected to be much lower: 4.4% for Lackland and 5.7% for Fort Sam Houston.

In addition, installation personnel are considering the following three groups of alternatives which could reduce withdrawals from the Edwards aquifer: new water sources, reclaimed water sources for industrial uses as well as grounds and golf course irrigation, and conservation measures. New potable water sources include obtaining surface water from projects being posed by existing surface water purveyors. One potential surface water project involves the Guadalupe-Blanco River Authority (GBRA) transferring treated Guadalupe River water from Lake Dunlap to Bexar County. If initiated the project would be completed in 2001 at the earliest and would provide either 15,000 or 65,000 acre-feet/year, depending on the construction option selected. The second potential source of surface water is Bexar Metropolitan Water District's (BMWD) plan to transfer about 10,080 acre-feet/year of Medina River water to southern areas of San Antonio. Other alternative new water sources could include the purchase or lease of irrigation water rights. These options require investigation and would be highly dependent upon regulatory and, in some cases, other environmental issues being resolved, and may not be available until after the time period associated with the scope of this consultation.

Reclaimed wastewater effluent (reuse water) is another means to reduce Edwards aquifer water withdrawal. The uses of non-potable reclaimed water are broad, with turf irrigation being the primary proposed use at the military facilities. Randolph AFB holds rights to obtain reclaimed water from the Cibolo Creek Municipal Authority (CCMA) equal to 70% of the volume of wastewater the base conveys to CCMA. SAWS is currently beginning construction of two water recycling systems that can serve three military installations considered in this opinion. The SAWS Leon Creek branch could serve Lackland and potentially provide more reuse water to Kelly AFB and the SAWS Salado Creek Branch will pass near Fort Sam Houston and the VA Cemetery located on Fort Sam Houston. The use of reclaimed water for industrial purposes such as aircraft washing, vehicle washing, and cooling systems is also being planned. DOD is committed to converting all portions of the installations that would benefit from the use of reuse water and are investigating all options. However, some portions of the installations may not be converted from Edwards water because it is economically impossible to run reuse lines to those parts of the bases. In the supplemental information provided on the biological assessment on March 19, 1999, DOD states it does believe curtailing discretionary use is appropriate. The installations are committed to using water from the Edwards aquifer wisely.

Water for both discretionary and nondiscretionary purposes will continue to be used efficiently and conservation efforts will be increased. Conservation measures are grouped into two categories: infrastructure components and educational programs. Each installation assesses the feasibility and compatibility of various conservation methods with its missions. A secondary objective for on-installation conservation measures and education programs is for employees to apply these programs at their residences.

Infrastructure conservation includes studies, modifications or improvements to the water distribution systems and water use fixtures. These may include leak detection, repairs, metering, repair and replacement of faulty fixtures and conversion to low or no flow devices. Industrial conservation could include cooling tower recycle studies, kitchen operations, car wash water recycling systems, and aircraft/large vehicle wash water recycling. Other miscellaneous conservation methods could include using pool covers, reusing water for irrigation, xeriscaping, rainwater and grey water collection, and curtailing use of ornamental fountains.

Educational conservation practices that have been and/or could be implemented include such actions as wide-spread distribution of water conservation goals, practices, and achievements in the form of kits, pamphlets, posters, ads, fact sheets, conservation training seminars, and incentive programs to reduce water use.

Drought Management Plans (DMPs)

Drought management plans currently being implemented at the four bases were based on EAA's Critical Period Management Plan that was in effect until EAA's rules were declared invalid for want of substantial compliance on December 1, 1998. (Cause No. 97-13983: *Carson B. Wells, et al. V. Edwards Aquifer Authority, et al.* and Cause No. 98-02644: *Living Waters Artesian Springs v. Edwards Aquifer Authority*). The trigger levels in both DOD's and EAA's plans are based on the elevation of the J-17 index well located on Fort Sam Houston. Each base has three to four stages, which vary from base to base, and prescribe specific demand reduction measures and the associated Edwards aquifer J-17 well level at which they occur. Stages are usually required to run 10 days unless the well level drops sufficiently to impose the next stage. Table 7 summarizes the various stages and trigger levels used at the installations now.

Reduction goals are accomplished by setting time and/or day restrictions on irrigation of lawns, landscapes, or golf courses. The type of irrigation method may also be set. Limits are set on car washing, fire hydrant and sewer line flushing, and water to be served at eating establishments. Ongoing public education campaigns are intensified. Each stage gets progressively more restrictive and prohibitive of some actions. Other reduction methods may include closing pools and gymnasiums or non-essential facilities and prohibiting all water use not necessary for military readiness, safety of personnel and mission of the installation.

Table 7. DOD Current Drought Plans

Stage Level	J-17 Trigger Level	Reduction Goal
I	655 to 650 feet	1.7 X average base usage*
II	642 to 640 feet	1.6 X average base usage
III	636 to 620 feet	1.4 X average base usage
IV	632 to 628 feet	1.3 X average base usage
V	628 feet and below	

*Average base usage is defined as the average usage for the three lowest usage months of winter during the November 1995 to February1996 time frame.

The Service has indicated that the probability of survival and recovery is significantly reduced for certain endangered species when flows go below 150 cfs at Comal Springs and 100 cfs at San Marcos Springs (USFWS letters dated April 28, 1993 and June 25, 1993). The existing DMPs allow flows at Comal to go to about 160 cfs during level I and down to 60 cfs before level V (the emergency level) is implemented. During litigation procedures, *Sierra Club, et. al. v. Lujan, et. al.* (it would later become *Sierra Club, et. al. v. Babbitt, et. al.)*, No. MO-91-CA-069, Joe G. Moore, Jr., Court Monitor for Judge Lucius D. Bunton, US District Court, Western District of Texas was appointed and made the recommendation to the Court in August 1, 1994, and in a revised plan on March 31, 1995, that to assure necessary flows for listed species at Comal and San Marcos Springs, spring flow rates at Comal (and possibly San Marcos) should be used as triggers instead of the J-17 index well level. The Service is concerned that during low springflows the J-17 well levels and springflows do not correlate well and existing DMP stages do not provide enough protection to protect spring flows and avoid jeopardy. Therefore, the Service concurs with the court monitor's suggestion that springflows should be used and reductions should be started much earlier (for example, by 250 cfs at Comal Springs).

DOD, in their supplemental information for the biological assessment dated March 19, 1999, proposed an alternative DMP (Table 8), based on the J-17 index well and correlations to Comal Springs springflow levels (Guyton and Associates, 1979; Wanakule 1988). The stages in this new proposed DMP are triggered earlier than DOD's current drought plan and EAA's plan. DOD stated they believed that the military's proposed alternative DMP would result in earlier protection levels and minimize impacts to the species in times of drought.

To address the Service's concerns that relying solely on aquifer levels in J-17 as a trigger level may not be adequate to protect necessary flows for the listed species, the Service recommended the triggers in Table 10 be used rather than those in Table 8. Using this scenario, aquifer levels could be used unless springflow drops to or below the Service's recommended springflow trigger level for 3-5 consecutive days. If after 5 days the Comal

TABLE 8. Various Recommended Critical Period Management Stage Controls (Proposed by DOD as of 3/19/99)

Stage Level	USFWS Recommended Trigger Flow at Comal Springs	Military Trigger Level at J-17 Well	EAA Trigger Level at J-17 Well	Average Comal Flow for EAA Trigger	Multiplier	Installations Maximum Monthly Withdrawal
I	250 cfs	657.5 ft	650 ft	214.0 cfs	1.7	1,436 ac-ft
II	200 cfs	647.0 ft	642 ft	180.0 cfs	1.6	1,352 ac-ft
III	180 cfs	642.0 ft	636 ft	134.5 cfs	1.4	1,183 ac-ft
IV	160 cfs	640.5 ft	632 ft	103.5 cfs	1.3	1,098 ac-ft

NOTES:
1. cfs = cubic feet per second ft = feet ac-ft = acre-feet

springflow (cfs) level has dropped to or below the Service's recommended trigger level or after 3 days at or below 80 cfs at San Marcos, but the J-17 well level has not triggered the respective stage, then the springflow discharge will supercede the aquifer level as a trigger and the next stage will be implemented. The Service also recommended adding a Stage V, for when conditions are even more dire at Comal and/or San Marcos (See Table 10). The reason that such a low flow (80 cfs) was used as a trigger for San Marcos is because during a typical decline in aquifer levels San Marcos springflows decreased at a slower rate than Comal discharge, and Comal levels would more likely trigger initial stages of the DMP. However, there are periods in the historic record where this would not have been the case. Having the San Marcos 80 cfs trigger level at each stage would be more feasible for DOD to progressively move from one stage to another and avoid a situation where DOD would have to skip a stage. Each stage will be in effect for 10 consecutive days unless a more restrictive stage is implemented and will not be rescinded until the 10 day rolling (moving) average of the J-17 index well and springflow levels trigger a less restrictive stage.

DOD has agreed to the proposed drought management plan in Table 10. All four installations considered under this opinion will adopt the same trigger levels and implement them simultaneously. DOD also agrees that once EAA has adopted a DMP of their own, that if EAA's plan is more stringent than the one in Table 10 they will abide by the EAA DMP.

Required water reductions will be determined using the Installation Base Withdrawal Volumes (BWVs). BWVs will be established by averaging monthly usage data for the period November 1995 through February 1996 using the lowest three months of that period. This is the same period EAA has used in their Critical Period Management Plan. The base volume approximates the installations' monthly nondiscretionary usage and will be used to determine maximum allowable pumped withdrawals during low flow critical management periods. (Note: annual limits may also not be exceeded.) The total BWV for the four military installations that pump from the Edwards aquifer is 844.9 acre-ft/month (Supplemental Information provided on March 19, 1999) (Table 9).

The base volume approximates the installations' monthly nondiscretionary usage (i.e. without the impact of irrigation demands) (Supplemental Information provided March 19, 1999). When the critical period stage controls are implemented, installations will adhere to stage restrictions as specified in the DMP. Critical period reduction multipliers (shown in Table 9) are multiplied times the installations' BWV and establish the monthly allowable pumped volume during the respective stages. Maximum Pumped Volumes (MAX-PV) represent the maximum monthly withdrawal for the installations under critical period stage reductions. The installations aggregate MAX-PV for each stage is shown in Table 10.

Table 9. Monthly use volumes (in kilo-gallons/month)

Installation	Nov 95	Dec 95	Jan 96	Feb 96	Monthly Average
Fort Sam Houston	~~87,865~~	67,200	84,600	84,035	78,611.7
Kelly AFB	70,196	73,402	~~77,408~~	74,806	72,801.3
Lackland AFB	91,585	98,728	~~105,579~~	102,038	97,450.3
Randolph AFB	~~29,446~~	25,288	26,354	27,679	26,440.3
Total					275,303.6

Notes:
(1) Values with strike-through were not used in calculating monthly averages.
(2) 275,303.6 kilo-gallons/month = 844.9 acre-ft:/month

The multiplier and maximum monthly withdrawal for Stage V is calculated as follows. Employing a Seasonal Demand Curve developed for the San Antonio Water System (SAWS) by their consultant engineer (Pape-Dawson Engineers, Inc.) and referred to in DOD's August 30, 1999 letter, the current (1998) DOD discretionary water usage (1562.7 ac-ft/yr) can be distributed over an annual period. The resulting curve was then overlaid on the DOD 10-year Groundwater Withdrawal Record, using the years 1989 to 1998 minus the highest and lowest years (1989 and 1997). The total annual discretionary usage for the San Antonio military installations during 1998 was 1562.7 ac-ft or 16.5% of the annual record. Using this data point as representative of a typical year, the total volume of discretionary usage extrapolated from the DOD 8-year Groundwater Withdrawal Record is calculated as 16.5% of the 8-year average withdrawal volume (11,378.675 ac-ft) or 0.165 X 11,378.675 ac-ft = 1,877.4813 ac-ft/yr. Using the critical month August (which according to DOD's last 10 years of record is their highest use month, on average) with 13% of the annual discretionary usage volume (per the Seasonal Demand Curve), the volume of discretionary usage for August is calculated as 0.13 X 1,877.4813 ac-ft = 244.07256 ac-ft. Subtracting the August discretionary volume (244.07256 ac-ft) from the monthly 8-year historical average for August (1,245.75 ac-ft) or 1245.75 - 244.07256 = 1001.6775 ac-ft, the mission critical (non-discretionary) volume required to sustain installation operations. The Stage V multiplier is calculated by dividing the mission critical volume by the DOD BWV or 1001.6775 ac-ft / 844.9 ac-ft = 1.185. Therefore, DOD should be able to reduce Edwards water use to this level (basically cutting out all discretionary water use) during a dire situation when flows are below those levels at which the fountain darter, Texas wild-rice, and Comal Springs riffle beetle's probabilities of surviving are being significantly reduced. It is important to note that this method or time frame may not be the most appropriate for other applicants seeking coverage under a Section 7 consultation or Section 10(a)(1)(B) permit, and will need to be determined on a case-by-case basis for other applicants, using the most appropriate method for determining water use necessary to maintain human health and safety.

Table 10. New DOD Drought Management Plan Staged Reductions

Stage	Triggers*			Multiplier	Installations Total Maximum Monthly Withdrawal
	J-17	Comal	San Marcos		
I	5 days where Level ≤ 657.5 ft	5 days at or below 250 cfs	3 days at or below 80 cfs	1.7	1,436 acre-ft
II	5 days where Level ≤ 647.0 ft	5 days at or below 200 cfs	Any Stage I trigger, plus 3 days at or below 80 cfs	1.6	1,352 acre-ft
III	5 days where Level ≤ 642.0 ft	5 days at or below 180 cfs	Any Stage II trigger, plus 3 days at or below 80 cfs	1.4	1,183 acre-ft
IV	5 days where Level ≤ 640.5 ft	5 days at or below 160 cfs	Any Stage III trigger, plus 3 days at or below 80 cfs	1.3	1,098 acre-ft
V	3 days where Level ≤ 637.0 ft	3 days at or below 100 cfs	Any Stage IV trigger, plus 3 days at or below 80 cfs	1.185	1,001 acre-ft

* Whichever comes first.

Water Quality

Monitoring and maintaining good water quality is also important. Faults and wells that penetrate both aquifers are potential routes by which contaminants may flow into the Edwards. The potential for contamination of the aquifer is addressed in the DOD's Installation Restoration Program (IRP). The (IRP) is a program that evaluates past disposal sites, controls the migration of contaminants, minimizes potential hazards to human health and the environment, and cleans up the contamination. The Kelly AFB PEIS identified 52 IRP sites and three Areas of Concern. Some of the contaminants identified at Kelly AFB included low-level radioactive waste, jet fuel, solvents, cyanide solutions, tar, chromium plating sludge solvents, gasoline, PCBs, phenols, pesticides, TCE, PCE, DCE, JP-5, and TPH. Significant areas of the shallow aquifer and soils were found to be contaminated and are addressed in the original Kelly biological opinion, which still stands. Well inspections and IRP studies have not identified other water quality issues on the remaining installations, therefore this biological opinion does not address any water contamination impacts directly to the aquifer from DOD, other than those in the Kelly biological opinion. If any aquifer contamination issues are later identified or expected, DOD will need to consult with the Service further.

Other Measures

As stated previously, DOD and the Service recognize the logistical constraints of time needed to put effective reduction measures in place and the complicated nature of the cumulative effects of many regional users contributing to the decline of the resource. It will be a difficult task to find ways to solve these issues, implement projects, and fairly and equitably distribute the responsibility of accomplishing these tasks among all users.

The Service examined the biological and logistical issues involved and determined that an approach that involves steady reductions in aquifer withdrawals over a certain time could meet the time and economic/logistical needs of planners trying to implement comprehensive solutions to meet reduction goals that can ensure the survival of the species and their critical habitat. In addition, the Service believes that in the interim period as measures are being put in place to reach these reduction goals, the risk to species survival will still be high. The risk can be reduced by implementing a significant drought management plan for further cut-backs to protect flows during drought and by implementing additional conservation actions in those initial years to reduce negative impacts to the species during drought and low flows and increase the species' chances of surviving during temporary low flows. These actions may include such things as:

- improving the condition of species and habitat in the wild so that they are in better condition going into the low flows and so that the relative portion of the population impacted will be less;
- answering information needs to better manage flows and minimize impacts to species and;

- maintaining captive populations to act as a backup for wild populations and enhance the chances of restoration.

We have developed a list of possible projects that could serve one of these functions (See Appendix A). Each project on this list has been assigned a point value (based primarily on relative cost). The total of all of these points = 10,000. To determine a pumper's "fair share" of these impact and risk reduction/minimization measures, we multiply the pumper's percent water use (average historic use) by the total points (10,000). So in the case of the four installations, whose combined average historic water use (12,264.638 acre-ft/yr.) is 2.6%, their fair share of these measures would be 0.0262887 X 10,000 = 262.887 points. DOD has decided to fund refinement of the regional Edwards aquifer model to improve the ability to manage the aquifer in a way that minimizes impacts to the species. This task has applicability to pumpers and to aquifer management region wide. This task was also assigned a high priority by a Technical Advisory Group (TAG) appointed by the EAA to help identify and design research necessary to assist in aquifer optimization. The Service assigned a point value to the model of 200 points and anticipated the share of funding that would be contributed for these 200 points to be $200,000. The total cost of the project is estimated to be $400,000 in years 1 and 2 for model/GIS construction. DOD has agreed to fund a minium of $262,887. The extra $62,887 should free up EAA funds that would have been spent on this project that can now be spent on other tasks on this list such as flow path studies around San Marcos or the establishment of a monitor well in San Marcos to correlate aquifer level and springflow.

Status of the Species

Fountain darter (*Etheostoma fonticola*)

The fountain darter occurs in both the upper San Marcos and Comal rivers. The fountain darter was listed as endangered on October 13, 1970 and critical habitat was designated on July 14, 1980. Critical habitat was designated in Hays County and includes Spring Lake and its outflow, the San Marcos River, downstream to approximately 0.5 miles below the Interstate Highway 35 bridge. A field identifier of the downstream end of critical habitat is considered to be the U.S. Geological Survey defunct gaging station. There is no critical habitat designated for this species in the Comal Springs system.

The fountain darter is a small reddish brown fish, averaging about 29 mm (about 1 1/4 inches) total length. Habitat requirements described in the recovery plan (USFWS 1996) include: undisturbed stream floor habitats; a mix of submergent plants (algae, mosses, and vascular plants), in part for cover; clear and clean water; food supply of living organisms; constant water temperatures within the natural and normal river gradients; and adequate springflows.

Fountain darters feed primarily during daylight in response to visual cues (Schenck and Whiteside 1977*a*). Bergin (1996) investigated the fountain darter's diet in detail. The food

items selected depend on the size of the individual, but primarily includes copepods, dipteran larvae, and emphemeropteran larvae (Bergin 1996).

Fountain darters use and may prefer a mix of submergent plants and mats of filamentous algae (Schenck and Whiteside 1976; Linam 1993). Schenck and Whiteside (1976) found that young fish prefer vegetated habitats in areas with little water velocity, while adults occur in all types of suitable habitats including riffles.

Although natural populations of fountain darters appear to spawn year-round (Strawn 1955, 1956 as cited in USFWS 1994; Schenck and Whiteside 1977*b*), they appear to have two peak spawning periods, in August and late winter to early spring (Schenck and Whiteside 1977b). Bonner et al: (1998) described the effects of temperature on egg production and early stages of the fountain darter.

Historic and present distributions of the fountain darter are presented in the *San Marcos & Comal Springs and Associated Aquatic Ecosystems (Revised) Recovery Plan* (Recovery Plan) (USFWS 1996). Historically within the San Marcos River, the fountain darter is known from the headwaters down to the vicinity of Martindale (USFWS 1996). Current distribution extends from Spring Lake to a point between the San Marcos Waste Water Treatment Plant (WWTP) outfall and the confluence with the Blanco River (USFWS 1996). Fountain darters have been collected below the WWTP outfall during July 1994, November 1994, February 1995, April 1995, and September 1996 by this office.

The original population of fountain darters in the Comal River was extirpated (Schenk and Whiteside 1976). The primary cause of extirpation is thought to be the 1956 drought, when springflow ceased for nearly four months. Cessation of flow probably caused large temperature fluctuations in residual pools. In 1954, rotenone was applied to remove nonnative and exotic fish. Although fountain darters were seined and held during rotenone application, the total number of fountain darters probably was reduced since all darters were not caught (Ball et al. 1952; USFWS 1996). The species was re-established in the Comal River in 1975 and 1976, and the species now occupies Landa Lake downstream to the vicinity of the confluence of the Comal and Guadalupe Rivers.

The population of fountain darters in the San Marcos River was estimated to be about 103,000 by Schenck and Whiteside (1976) and 45,900 (excluding Spring Lake) by Linam (1993). Darter densities appear to be highest in the upper segments of the river decreasing markedly in an area below Cape's Dam (Linam 1993; USFWS unpublished data; Whiteside *et al.* 1994). The area below the WWTP outfall has been identified in the recovery plan as an area to evaluate for possible restoration of habitat for the fountain darter. Linam et al. (1993) estimated that the Comal River population was about 168,078 individuals above Torrey Mill Dam in the 1990 survey.

Dr. Thomas Brandt (in litt. 1997) has summarized the parasite problems faced by the fountain darter. None of the fountain darters collected in the Comal system in June and early July, 1996 were observed to have swollen gills. On July 19, 1996, one of 11 fountain darters collected and released was noted as having swollen gills. This was the first indication of parasites attacking fountain darter gills in the Comal system. In October, 1996, heavy parasite loads were documented in Comal fountain darters including: metacercarial digenetic trematodes, a myxosporean, and an epithelial flagellate.

A significant threat to the health of fountain darters is the damage to gills and gill arches caused by the trematodes. The risk posed by these parasites appears to be related to spring discharge in the system. The summer of 1996 was well below average in terms of discharge at Comal Springs.

Currently, this trematode has not become established in the fountain darters of the upper San Marcos. A total of two trematodes has been found in San Marcos darters; one in each of two individuals. A recent cooperative study (SMNFH, Southwest Texas State University, and National Aquaculture Research Center (Stuttgart, Arkansas) found this trematode on every fountain darter collected in the Comal system. A major threat to health of fountain darters in the San Marcos system is this same undescribed trematode. Alternate hosts for these gill parasites may include animals found in both Comal and San Marcos systems. Yellow-crowned night herons, the trematode's postulated host, may easily fly from Comal to San Marcos.

San Marcos gambusia (*Gambusia georgei*)

The San Marcos gambusia was listed as endangered in 1980. Critical habitat includes the San Marcos River, from the Highway 12 bridge downstream to approximately 0.5 miles below the Interstate Highway 35 bridge (45 FR 47355). Intensive searches for *G. georgei* in May, July, and September of 1990 did not yield any pure San Marcos gambusia. Past attempts to establish a captive population were unsuccessful and no pure *G. georgei* have been found recently to try captive propagation again.

The San Marcos gambusia, one of three Gambusia species native to the San Marcos River system, was first described in 1969. The San Marcos gambusia has strong crosshatchings and a prominent dark pigment stripe across the distal edges of its dorsal fin. A mid-lateral stripe may be present from the base of the pectoral fin to the caudal peduncle. *Gambusia georgei* has a dark subocular bar and fewer spots than *G. affinis*. The median fins tend to be lemon yellow in wild-caught specimens, with dominant males exhibiting a bright yellowish-orange color. *Gambusia georgei* has more than five segments in ray 4a and a compound claw on the end of ray 4p (Hubbs and Peden 1969). According to the recovery plan (USFWS 1996), the habitat requirements of the San Marcos gambusia include: thermally constant water; quiet, shallow, open water adjacent to sections of moving water; muddy substrates without appreciable quantities of silt; partial shading; clean and clear water; and a food supply of living organisms. Food habits of *G. georgei* are unknown but are presumed to include insect

larvae and other invertebrates. Hybridization between *G. georgei* and *affinis* was first noted by Hubbs and Peden in 1969. Hybrid individuals may now be competing with *G. georgei*.

Texas wild-rice (*Zizania texana*)

Texas wild-rice was listed as endangered on April 26, 1978 and its critical habitat was designated on July 14, 1980. Critical habitat includes Spring Lake and its outflow, the San Marcos River, downstream to the confluence with the Blanco River.

The first collection of Texas wild-rice was by G.C. Neally in 1892 (USFWS 1996). The plant was formally described and named by Hitchcock in 1933 (taken from Terrell *et al.* 1978). Texas wild-rice is an aquatic, monoecious, perennial grass, which is generally 1-2 m (3.281 - 6.562 ft.) long and usually immersed and prostrate in the swift-flowing water of the San Marcos River. The inflorescence and the upper culms and leaves become emergent as flowering commences. Flowering and seed set occur primarily from late spring through fall but inflorescence may occur sporadically at other times in warm years (USFWS 1996). In slow moving waters Texas wild-rice plants function as annuals, exhibiting less robust vegetative growth, then flowering, setting seed and dying within a single season.

Texas wild-rice occurs only in Spring Lake and the upper San Marcos River, before the confluence with the Blanco River. Plants form extensive stands over the substrate, rooted in the limestone sand and gravel river bottom, which overlays Crawford black silt and clay (Vaughan 1986). Other native species that occur in the same general area of the river inhabited by Texas wild-rice include pondweed (*Potamogeton illinoensis*), eelgrass (*Vallisneria americana*), arrowhead (*Sagittaria platyphylla*), hornwort (*Ceratophyllum demersum*), and water primrose (*Ludwigia repens*). Non-native species now commonly present include hydrilla (*Hydrilla verticillata*), elodea (*Egeria densa*), and *Hygrophila polysperma*.

Distribution - When described in 1933, Texas wild-rice was indicated to be abundant in the San Marcos River, including Spring Lake and its irrigation waterways (Silveus 1933, Terrell et al. 1978).

In the 1960's and 70's investigators found very little Texas wild-rice remaining. In 1967 Emery found only one plant in Spring Lake, none in the upper 0.8 km (0.5 miles) of the San Marcos River, only scattered plants in the lower 2.4 km (1.5 miles), and none below this (Emery 1967). In 1976 no plants were found in Spring Lake, with the majority of plants concentrated in the extreme upper and lower segments of the San Marcos River (Emery 1977). Calculated areal measurement of wild-rice at that time was 1,131 m^2 (Emery 1977). Vaughan (1986) reported areal coverage of the rice from 1983 through 1986 to be 541, 462, 489, and 454 m^2, respectively. Texas Parks and Wildlife Department (TPWD 1989) has been

monitoring Texas wild-rice annually since 1989, and this ongoing effort has documented that recently Texas wild-rice had been growing through a slightly greater geographic area than during its most sparse period of record in the late 60's and mid 70's, though not all of these recorded stands have persisted (Poole and Bowles, 1996).

Records of wild-rice plants below the WWTP are limited to two. Sampling reports from yearly surveys (TPWD, 1989 through 1996) document that one stand of rice was located below the outfall in 1989, but this plant has not been relocated. A note included on a *Z. texana* habitat map from Emery's work dated 2-07-78, indicates 1 clump of Texas wild-rice at the entrance to a 10" diameter pipe on the north bank about 400 meters downstream from the city sewage outfall in 1976. This stand has not been relocated and is presumed lost.

Habitat and Life History - Silveus (1933) stated that Texas wild-rice was found growing in the swiftest currents at some distance from the bank rather than along the stream margins as he had expected.

Since these early habitat observations, our understanding of optimum habitat for Texas wild-rice has been refined. Optimum habitat for Texas wild-rice consists of relatively clear waters with high to moderate current velocities (0.3-0.6 m/sec) and depths between .5 m and 1 m (1.640-3.281 ft) (Poole and Bowles, 1996). Optimum depths and velocities are synergistic in determining optimum habitat. It has been observed in sites deeper than about 1.5 m, but stands do not do well. Minimum depths tolerable for Texas wild-rice are believed to be in the .2 to .3 m range, and this could be sustained only for a relatively short time (on the order of possibly a week to 10 days) as mechanical forces and vulnerability to other threats at these depths severely limit persistence. At the lower limits of depth, velocities of 0.3 to 0.6 m/sec are probably too high and would result in damage to the plants (Seal and Ellis 1997).

Flow rates may be extremely important to optimum growth for Texas wild-rice. Texas wild-rice requires carbon dioxide as its inorganic carbon source for photosynthesis rather than bicarbonate, which other aquatic plants commonly use (TPWD 1994; Seal & Ellis 1997) While bicarbonate is commonly available in solution in aquatic systems, carbon dioxide diffuses very slowly in water and is readily available only in relatively fast-moving waters and near spring openings. Obligate carbon dioxide using species may be carbon limited in low flow situations. Velocity has been shown to influence photosynthesis of submerged vegetation (Madsen and Sondergaard 1983; Prins and Elzenga 1989).

Substrate texture requirements are unclear. Experimental work by Power (1990) and Power and Fontyn (1995) concluded that seed germination was triggered by low oxygen in anaerobic sediments, and that seedlings grow well in fine textured sediments. Power has continued to grow plants from seed successfully in fine sediments for cultivated collections and subsequent experimental work. Poole and Bowles challenge that finding and state, based on transect studies of Texas wild-rice in its natural habitat in 1994 and 1995, that Texas wild-rice grows preferentially in coarse to sandy substrate. However, it should be noted that Poole and Bowles

took substrate samples on the edges of the wild-rice stands to avoid root impacts. Substrate characteristics there may be influenced in part by the impact of the stand itself on flow dynamics around the stand, and may be slightly different than those on the interior of stands. Later (1996) collection of wild-rice specimens for the captive conservation collection involved collecting plants from over 80 sites in the river and observations about substrate texture were made at the time of collection. These collections were taken for the most part more in the interior, receding half of stands. Observations of these collections include many sands and fine sands, frequently with silty components. Additional work is probably needed to clarify the sediment texture tolerances and requirements of Texas wild-rice.

Reproduction of *Z. texana* occurs either sexually via seeds or asexually (clonally) through stolons. Sexual reproduction occurs through formation of seed produced from wind pollinated florets. Texas wild-rice seed is not long-lived, and no appreciable seed bank would be expected. Viability begins to drop markedly within one year of seed production. Asexual reproduction occurs where shoots arise as clones at the ends of rooting stolons (Emery and Guy 1979).

The genetic variability present in the wild population of Texas wild-rice is currently under investigation, and complete results are not yet available. It has been demonstrated that plants in patchy or changeable environments with a variety of microsites may have high genetic variability that is of adaptive importance (Harper 1977). In spite of the fact that the species has reproduced predominately clonally for many years, it cannot be assumed that this has resulted in a relatively homogeneous population. Most clonal plant species surveyed for genetic variation have shown a high degree of genetic diversity (Silander 1985). Established stands of clonal grasses of *Festuca rubra* have been documented to average as many as 5 different clones in a 15 by 15 cm quadrant (Harberd and Owen 1969, as discussed in Harper 1977). Preliminary tests on three samples of Texas wild-rice taken within less than a quarter mile length of river revealed that all three samples were genetically different individuals (Christie McKinnon, University of the Incarnate Word, pers. comm.). Until complete results of genetic variability levels within and between stands are available for evaluation, the potential for adaptively significant variability within stands and between stands cannot be discounted, and all existing stands should be accorded high priority for protection.

Most areas where Texas wild-rice still occurs are within areas recorded as having plants in the location of "clones" mapped by Emery in the late 70's and earlier. TPWD monitoring since 1989 has demonstrated stands are capable of relatively long-term persistence and expansion over large areas of substrate. Based on these observations of persistence and its perennial nature, Texas wild-rice does not appear to be a purely successional species with a dynamic, cyclic life history strategy. Successional species adapted for rapid colonization of highly disturbed environments generally rely on frequent dispersal of large numbers of propagules to colonize open sites. Successional stands that become established are usually relatively short-lived, declining and becoming displaced as the site is stabilized and occupied.

Few new stands of wild-rice have been documented in the river system since 1989. While rooted floating fragments of Texas wild-rice have been observed, which could potentially become established if deposited in suitable conditions, this mechanism is not believed to give rise to significant numbers of new stands. Clonal reproduction appears to be the primary mechanism for expansion of an established stand, but it does not appear to be an efficient mechanism for dispersal and colonization of new areas. A life-history strategy using sexual reproduction for dispersal and asexual reproduction within the parental habitat is common in both plants and animals (Sebens and Thorne 1985). Seed production may be essential for dispersal and establishment of new stands in Texas wild-rice.

Abundance and trends - In 1989 TPWD initiated a new monitoring program with new techniques. Data from 1989 on is likely not comparable to previous areal coverage measurements due to differences in techniques. Continuing from 1989 through 1994, areal coverage over the river as a whole has been 1005, 1380, 1406, 1406, 1592, 1501, 1624, and 1652 m^2, respectively (Poole and Bowles 1996).

TPWD reports generally include total cover in the river in m^2, total cover designated within lettered (A,B,C, etc.) river segments, and individual stand-by-stand history. Evaluating the condition of Texas wild-rice based on total areal coverage alone and even by comparison of cover within individual segments could give the impression that overall Texas wild-rice is increasing and doing well in the habitat. However, such an evaluation would fail to recognize events that are of great conservation concern. A more detailed, stand-by-stand analysis of the fate of individual stands is necessary. Although more frequent monitoring would be desirable, because of financial and staff constraints, TPWD has only been able to conduct quantitative monitoring annually. As discussed later, in some situations (such as events that occur seasonally or short-term low flow events) this may result in underestimates of losses and impacts.

Examining all the segments of the river monitored reveals that only in 2 of 14 river segments recognized to have potential habitat has wild-rice achieved significant, persistent expansion (segments B and K). Many stands have fluctuated in size from year to year, with frequent significant drops in cover. This raises concern about overall stability in the area and the potential loss of genetic material with each significant loss. Within almost every segment several stands have disappeared altogether, which also represents a loss of potentially important adaptive genetic material. Many stands and several entire segments (A,H,I, and J which together represent 16% of the recovery area needed for downlisting) show an overall decline in the recent monitoring record (1989-present). These low-level and/or progressive losses of genetic material are of particular concern since sexual reproduction and recruitment of significant numbers of new plants or stands is not occurring. On close examination some records of new stands may be due to the fragmentation and thinning of existing stands rather than to expansion. These fluctuations need to be carefully analyzed in the context of their location and local and system-wide threats to identify and manage problems that may be causing losses or declines (USFWS 1996).

Plants have not successfully been producing any significant quantity of seed in the San Marcos River for many years (Emery 1977; Vaughan 1986; USFWS 1996). Photos taken near the A.E. Wood Fish Hatchery (historically one of the most robust areas for Texas wild-rice) in the 80's show a stand blooming well (Paula Power, research photos). Since TPWD's annual monitoring began in 1989 however, little inflorescence formation has been noted, and only on one or two occasions have any inflorescence been observed to have set a few seed (Jackie Poole, TPWD, and Paula Power, SMNFH, pers. comm. 1995). Plants grown in raceways in cultivation under protected conditions bloom well and produce seed in quantity (Rose and Power 1992). The failure of river grown wild-rice to produce seed in the wild is not thought to be a result of genetic, cytological, or embryological problems, but rather to some extrinsic factor or factors (Emery and Guy 1979). Triggers for flowering are not well understood. Herbivory, particularly by waterfowl, is believed to contribute to inflorescence losses. Impacts by recreational users of the river has also been postulated to interfere with flowering and seed set.

Low flow incidents are of particular concern because of the potentially catastrophic impact such events can have on Texas wild-rice. During recent low flow years in 1990 and 1996 significant numbers of Texas wild-rice stands were recorded in depths below optimum. Six out of 11 segments identified that currently have stands of wild-rice had more than 30% of their stands below optimum depth conditions. Four out of 11 segments had more than one-third of stands at depths below the minimum needed for survival (Table 11). Table 11 likely under-represents actual losses in dry years because sampling frequency was limited and may not have encompassed and reflected the total change as flows declined. (See note at the bottom of Table 11.)

The drought conditions in 1996 resulted in direct and indirect adverse impacts to the existing Texas wild-rice plants. In May low flows resulted in the dewatering of significant portions of large stands in TPWD monitoring segments, particularly segments A, E, and F with these stands suffering losses of over 50% of stand area. These three segments together comprise about 25% of the proposed recovery area needed for downlisting of the species. Most plants that died had not resprouted from potential below ground root material by the following spring. Some areas formerly occupied by Texas wild-rice were colonized by hydrilla, and the ability of wild-rice to recover and recolonize these sites is unknown (USFWS photo documentation and observations).

Several high velocity areas not actually dewatered became significantly shallower and had increased velocities that resulted in very short yellowish leaf growth and eroding root balls and some plants eventually being washed out. Low flow areas that became shallow and accessible suffered severe predation by nutria and other predators, resulting in the loss of significant leaf biomass.

In deeper water areas, reduced flows resulted in leaves of wild-rice floating at the water's surface rather than streaming just below the surface in the current as is normally the case.

This resulted in increased accessibility for herbivorous waterfowl (ducks and geese), which were observed feeding on Texas wild-rice (USFWS photo documentation and observations).

In some deep water areas, (particularly in segments B, G, J, and K) root balls of large established plants were also observed to be eroding and exposed, apparently because changes in flow characteristics changed the velocities through these areas (USFWS/TPWD observations, 1996).

Low flows also resulted in floating mats of vegetation fragments (which normally move slowly downriver) becoming hung up in wild-rice leaves that were near the surface, increasing in size and shading out wild-rice as well as mechanically damaging plants (Paula Power, Southwest Texas State University, and Melani Howard, City of San Marcos, pers. comm., and USFWS observations). Detrimental contacts from recreational users were also thought to have caused more severe and frequent damage to wild-rice because leaves were closer to the surface and more extensive shallow areas resulted in wading and horseplay in areas where under more normal flows greater depths would have afforded plants more protection.

Recovery needs - The recovery plan calls for establishing healthy, self-sustaining, and reproductive populations throughout the historic range before the species can be considered for downlisting. Recovery criteria call for 75% cover in prescribed areas of potential habitat for wild-rice, which is the percent cover typical of that found in healthy, vigorous stands (USFWS 1996). These prescribed areas which need 75% cover are delineated by the segment designations used in the TPWD monitoring program on Table 11.

Threats - The Recovery Plan identifies the potential loss of springflows needed to support riverine habitats as a primary threat for Texas wild-rice. Current water use trends indicate that without conservation action and reduction in demands for Edwards aquifer water, low flow periods of increasing frequency and duration can be expected, with associated significant impacts to Texas wild-rice.

Various threats to the wild-rice documented by Emery in 1967 included floating debris, bottom plowing, plant collection, and pollution. Although by 1977 Emery reported that the impact of bottom plowing and plant collecting had been significantly abated, restoration of sexual reproduction or appreciable spread of existing clones had not occurred.

Beaty (1975) noted that the location of the habitat for the wild-rice was in a densely populated and high use area, which subjected these waters to pollution by inflows of the city storm drainage system, occasional raw sewage leaks, and normal stormwater runoff from streets, railroads, and recreational areas. In addition, Vaughan (1986) identified competition by introduced and native species of plants, predation by animals (*Myocaster coypus* [nutria], and *Marissa cornuarietis* [the giant rams-horn snail]), recreational use of the river, and dam placement along the river as potential factors impacting the wild-rice.

Table 11. Texas wild-rice

Segment delineated	Square meters needed for downlisting	% of total recovery area needed for downlisting	% of existing stands below min. depth in dry yrs. 7/90 or 7/96	% of existing stands below optimum depth in dry years 7/90 or 7/96
Spring Lake	1500	13%	no rice	no rice
Segment A	1400	12%	63%	83%
Segment B	5000	42%	1%	17.7%
Segment C	1000	8%	24%	50%
Segment D	100	1%	no rice	no rice
Segment E	500	4%	12%	23%
Segment F	900	8%	0 ***	14%
Segment G	100	1%	0	0
Segment H	30	0.3%	50%	75%
Segment I	50	0.4%	50%	56%
Segment J	400	3%	35%	57%
Segment K	700	5.9%	17%	28%
Segment L	100	1%	no rice	no rice
Segment M	100	1%	no rice	no rice
Total	11,930			

*** Note that while monitoring conducted in July 1990 and 1996 in segment F did not reveal any stands below minimum depths for survival, it was observed that several large stands in segment F were partially dewatered and suffered losses of over 50% of their stand area in May of 1996. By the July monitoring session this loss had already occurred, and thus the depth of stand recorded was the depth of the "remainder" which was above the minimal survival depth. Therefore July 1996 monitoring depth measurements did not catch the stand expanses dewatered and lost earlier that year. Interestingly enough these losses were not reflected in areal coverage figures for segment F as a whole either, as expansion of a few deep-water stands in the segment over the coverage of the year before (1995) masked these effects in overall percent cover measurements. Only when examining the cover of individual stands in segment F between 1995 and 1996 do losses within segment F become apparent. Even these stand-by-stand measurements may be under-representative of losses, as pictorial records seem to show a more extensive percentage loss than the monitoring data. This may have occurred because stands that suffered losses had expanded in cover over the previous year (as had the deep water stands), until low flows exposed the stands. These phenomena may represent a potential to underestimate degree of risk to stands and losses actually sustained. If it could be implemented, more frequent quantitative stand-by-stand monitoring would provide a more accurate synopsis of events, particularly during low-flow events.

Rose and Power (1992) noted that nonpoint source pollution, floating mats of vegetation, recreational users of the river, and herbivorous waterfowl most likely have a negative impact on wild-rice, as well as changes in the composition of sediments, depletion of the soil seed bank, and plant competition particularly from the introduced hydrilla (*Hydrilla verticillata*) which has been observed surrounding stands of Texas wild-rice.

Additionally, Texas wild-rice may be more susceptible to damage from recreational activities and/or herbivores such as nutria, during times of decreased flow.

San Marcos salamander (*Eurycea nana*)

Eurycea nana was listed as a threatened species on July 14, 1980. Critical habitat includes Spring Lake and its outflow, the San Marcos River, downstream approximately 164 feet (50 m) from the Spring Lake Dam.

The San Marcos salamander is a neotenic form and retains its external gills throughout life. The salamander becomes sexually mature and breeds in the water. This small, slender salamander has moderately large eyes with a dark ring around the lens, well developed and highly pigmented gills, relatively short, slender limbs with four toes on the forefeet and five on the hindfeet, and a slender tail with well developed dorsal fin. Habitat requirements described in the recovery plan (USFWS 1996) include: thermally constant waters; flowing water; clean and clear water; sand, gravel, and rock substrates with little mud or detritus; vegetation for cover; and an adequate food supply. Captive salamanders do not actively pursue prey, but stay stationary until prey items are close enough to engulf. The San Marcos salamander's diet consists of amphipods, tendipedid (midge fly) larvae and pupae, other small insect pupae and naiads, and small aquatic snails. Most evidence suggests reproduction occurs throughout the year with a possible peak about May and June (USFWS 1996).

Recent sampling found the San Marcos salamander distributed throughout Spring Lake among rocks near spring openings,in algal mats, and in rocky areas just downstream from the dams (Nelson 1993). *Eurycea nana* occurs near all the major spring openings scattered throughout Spring Lake and is quite abundant at some of these springs (Nelson 1993). Nelson (1993) estimated a total population of 53,200 salamanders in and just below Spring Lake, including 23,000 associated with algal mats, 25,000 among rocky substrates around spring openings, and 5,200 in rocky substrates below Spring Lake.

Threats to the San Marcos salamander include loss of protective cover, lack of flowing water, water temperature elevated above ambient spring conditions, contaminants, siltation, and predators. *Eurycea nana* appears to require flowing water, as no specimens were found in still waters of the lake or river.

Habitat availability for the San Marcos salamander is adversely affected when springflows decline. The contingency plan for the salamanders is being implemented and salamanders are

being collected for captive propagation/maintenance at several different facilities. Techniques for breeding this species and maintaining its genetic diversity have not been worked out and there are no known techniques to ensure the survival of this species in captivity. Reintroduction techniques have also not been developed.

Texas blind salamander (*Typhlomolge rathbuni*)

The Texas blind salamander was listed as endangered on March 11, 1967. *Typhlomolge rathbuni* is a smooth, unpigmented troglobitic (cave-adapted) species. Adult salamanders attain an average length of about 12 cm (4.7 in.) with a large, broad head and reduced eyes. The limbs are slender and long with four toes on the fore legs and five toes on the hind legs. The salamander is neotenic and remains aquatic throughout its life in water-filled, cavernous areas in the San Marcos area of the Edwards aquifer. *Typhlomolge rathbuni* is believed to be adapted to the relatively constant 21° C (69.8° F) temperature of the subterranean waters in the Edwards aquifer (Longley 1978). The diet of the salamander includes amphipods, blind shrimp (*Palaemonetes antrorum*), daphnia, small snails, and other invertebrates. Cannibalism has also been documented (Longley, *in litt.*, 1994). The salamander appears to be sexually active throughout the year, which is expected since there is little seasonal change in the aquifer (Longley 1978).

The total distribution of this species may be as small as 10 km^2 (25.9 mi^2) in a portion of the Edwards aquifer beneath and near the city of San Marcos. All collections or sightings of the Texas blind salamander have occurred in Hays County, Texas. After its first collection at the former Federal fish hatchery site, the salamander has been found at Ezell's Cave, San Marcos Springs, Rattlesnake Cave, Primer's Fissure, Southwest Texas State University's artesian well, and Frank Johnson's well (Russell 1976, Longley 1978). The species was previously known to occur in Wonder Cave but searches in 1977 did not locate any specimens (Longley 1978).

The species could be negatively impacted by declines in water quality or quantity in the aquifer. Decreased water quality could also result from a reduction in the water level in the aquifer resulting in possible movement of the "bad water" line and decreased dilution potential.

Attempts are being made to collect Texas blind salamanders as part of the contingency plan implementation. However, very few specimens have been found at collection sites and these low numbers in captivity are inadequate to maintain good genetic representation. There are also no techniques developed to reintroduce this species back into the aquifer.

Invertebrates

The Service listed three aquatic invertebrate species known only from Comal and Hays counties, Texas, as endangered under the ESA on December 18, 1997 (Federal Register Volume 62, Page 66295). These species are dependent on the Edwards aquifer. The primary

threat to these species is described as a decrease in water quantity and quality as a result of water withdrawal and other activities by humans throughout the San Antonio Segment of the Edwards aquifer. Critical habitat was not designated for these species. The three species are reviewed below.

Peck's Cave amphipod (*Stygobromus pecki*)

Peck's cave amphipod, *Stygobromus pecki*, is a subterranean, aquatic crustacean that is eyeless and unpigmented. This amphipod is an obligate aquatic stygobiontic species, an aquatic species ecologically restricted to caves and subterranean groundwaters, found around spring openings of the Edwards aquifer. Limiting conditions for the amphipod may include decreased spring flow, stagnation of water, and decreased water quality.

The first recorded specimen of Peck's cave amphipod was collected at Comal Springs in June, 1964. Since then over 300 specimens have been collected, most from crevices in rock and gravel near the orifices of the three largest Comal Springs on the west side of Landa Park. The species has also been collected from a fourth Comal spring run adjacent to Landa Park and one specimen has been collected from Hueco Springs, about 7 km (4 miles) north of Comal Springs (Barr 1993).

Comal Springs riffle beetle (*Heterelmis comalensis*)

The Comal Springs riffle beetle, *Heterelmis comalensis*, has been collected from spring runs 1, 2, and 3 at Comal Springs in Landa Park and a single specimen has been collected from San Marcos Springs 32 km (20 miles) to the northeast.

The Comal Springs riffle beetle, in the family Elmidae, is an aquatic beetle about 2 mm (1/10 inch) long . The beetle is found in gravel substrate and shallow riffles in spring runs at depths of 2 to 10 cm (1 to 4 inches), sometimes deeper. Populations are at their highest from February to April (Bosse *et al*, 1988). Natural water flow is important for the respiration and survival of the riffle beetle, which has a mass of tiny, hydrophobic (unwettable) hairs on its underside to maintain a bubble of air for gas exchange (Chapman 1982). Stagnation of water and/or drying within the spring runs and the photic (lighted) zone of the spring orifices would probably be limiting for the riffle beetle, which depends on natural spring flows for respiration and survival (Chapman 1982).

In 1984 and 1990, some of the higher elevation Comal Springs ceased flowing and water levels in the index well (J-17) in San Antonio dropped to within twelve feet of the historic low of 612.5 feet that occurred in 1956 (Wanakule 1990). Flows also ceased in the upper spring run (Spring Run 1) in 1991 and 1996. Captive breeding techniques for this species have not been developed.

Comal Springs dryopid beetle (*Stygoparnus comalensis*)

The Comal Springs dryopid beetle has been collected from all 4 spring runs at Comal Springs and from Fern Bank Springs about 32 km (20 miles) to the northeast in Hays County. *Stygoparnus comalensis* is the only known subterranean member of the family Dryopidae. Adult beetles are about 3.0-3.7 mm (1/8 inch) long with vestigial (non-functional) eyes and weakly pigmented, translucent thin cuticle (Barr and Spangler 1992). This beetle does not swim and, since all known dryopid beetle larvae are terrestrial, the species may be associated with air-filled voids inside spring openings. Water flow is important for this species, which uses tiny, hydrophobic hairs on its underside to maintain a bubble of air for gas exchange (Chapman 1982). Decreased water flow and stagnation of water would be limiting factors for the beetle.

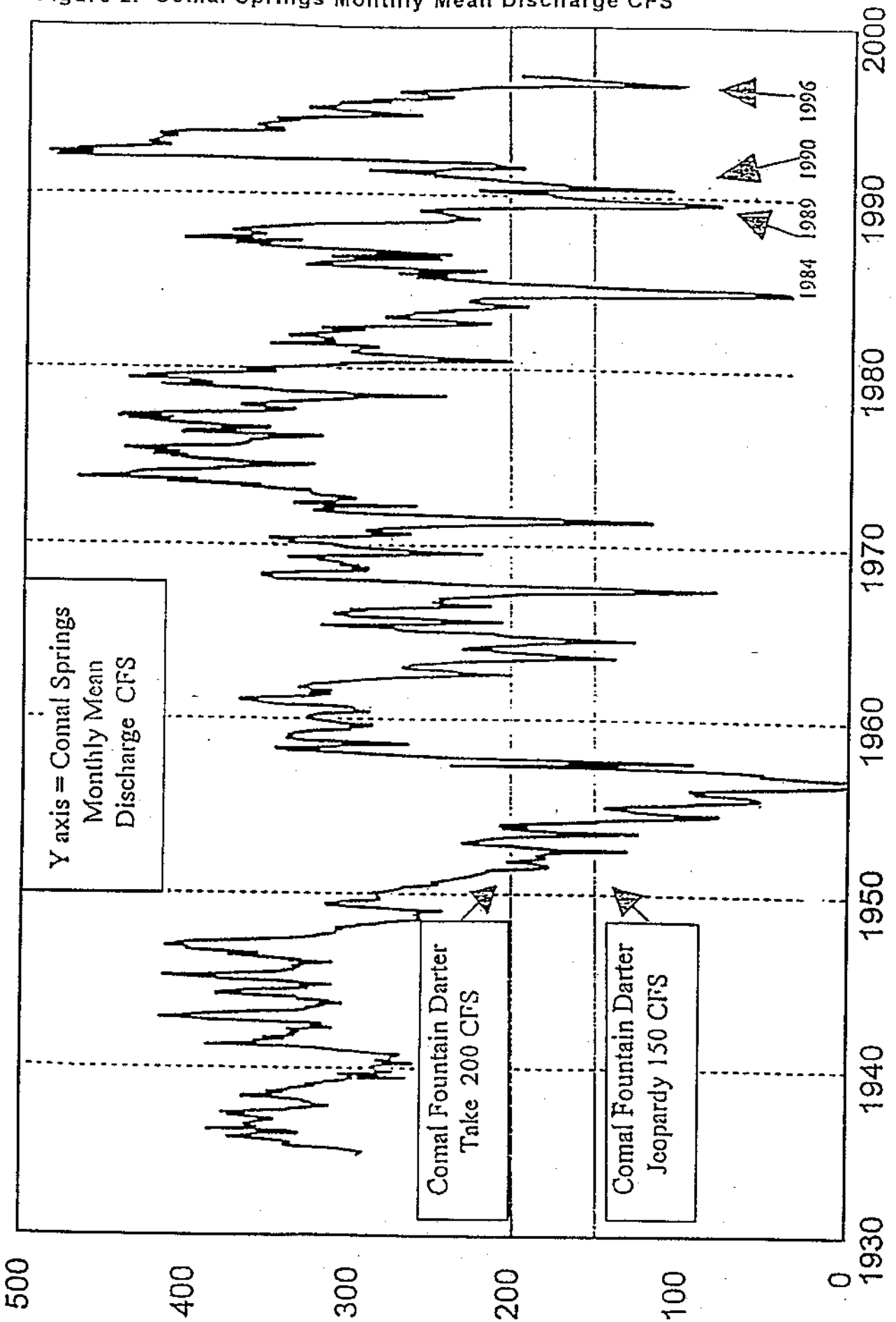
Other Species of Concern

In addition to the listed species, a great diversity of other unique species occur in these aquatic ecosystems. Some may be threatened with extinction, but insufficient information is available to fully assess their status. Some of the species associated with the Edwards aquifer include the Texas cave diving beetle (*Haideoporus texanus*), San Marcos saddlecase caddisfly (*Protoptila arca*), Ezell's cave amphipod (*Stygobromus flagellatus*), Texas salamander (*Eurycea neotenes*), Comal blind salamander (*Eurycea tridentifera*), robust (=Blanco) blind salamander (*Typhlomolge robusta*), Comal salamander (*Eurycea sp.*), widemouth blindcat (*Satan eurystomus*), and toothless blindcat (*Trogloglanis pattersoni*). While these species of concern have no legal protection, efforts to reduce adverse effects and/or further studies at this stage would benefit the health of the ecosystem and may help prevent future listing. Efforts to reduce effects or studies could include such things as studying well entrainment of blind catfish; developing or improving captive breeding techniques; or assessing habitat and flow requirements of these species of concern.

Environmental Baseline

The revised San Marcos and Comal recovery plan (USFWS 1996) identifies several local and regional threats to the aquifer and spring systems, and to the threatened and endangered species dependent on these ecosystems. The main regional threats are related to the quality and quantity of aquifer and spring water. Decreased and potential cessation of springflows threaten the survival of the aquatic species. Activities that may pollute the Edwards aquifer and its springs and streamflows may also threaten or harm the species. Additional threats include impacts from increased urbanization near the rivers, recreational activities, alteration of the rivers, habitat modification (for example, dams, bank stabilization, flood control), and

Figure 2. Comal Springs Monthly Mean Discharge CFS



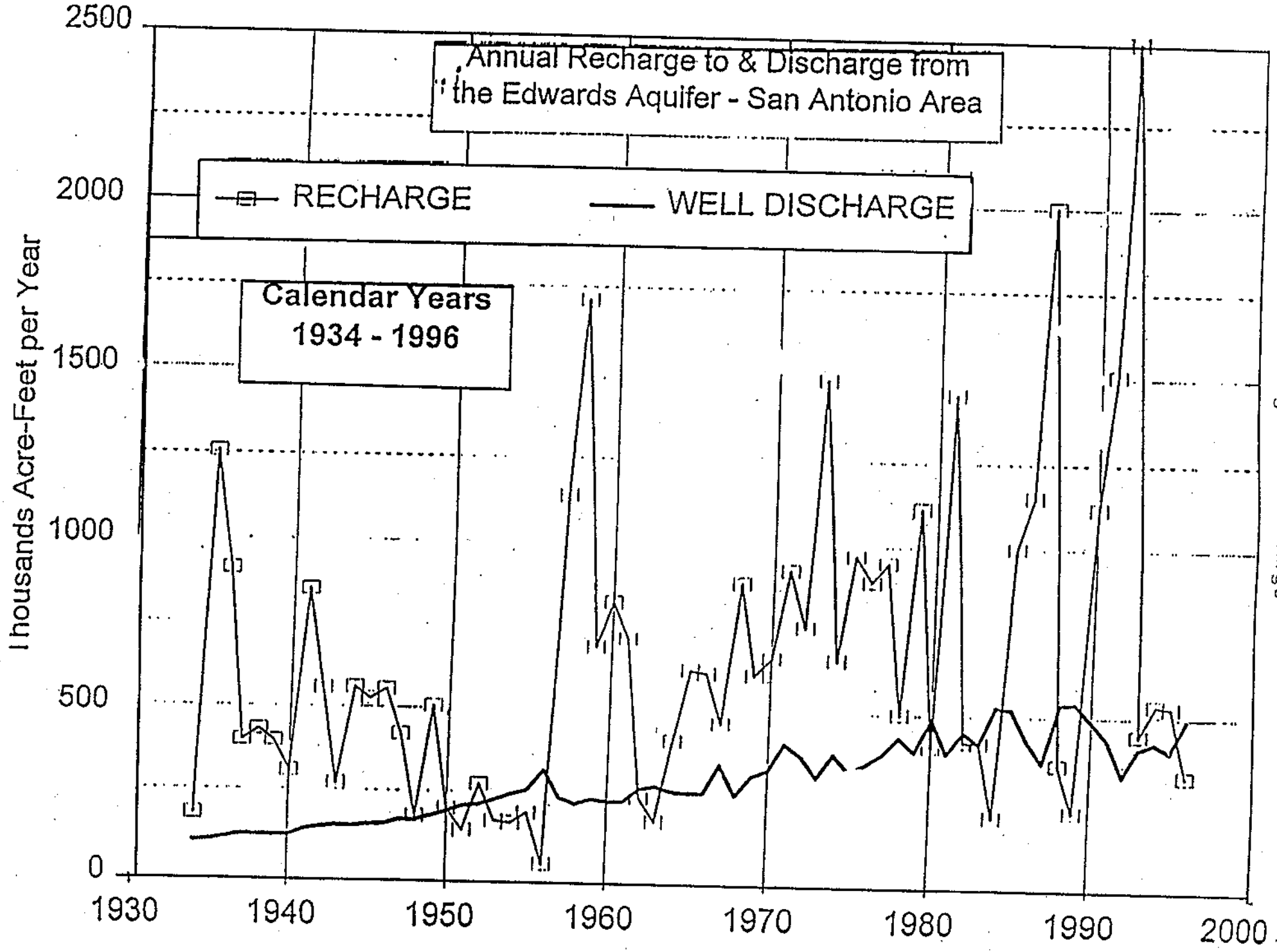


Figure 3. Annual Recharge to & Discharge

predation, competition, and habitat alteration by non-native species (for example, elephant ears, giant ramshorn snails, nutria, tilapia).

Springflows at San Marcos and Comal Springs are inseparably tied to water usage from the entire San Antonio Segment of the Edwards aquifer. The discharge of groundwater from wells in the aquifer decreases the flow of water from the springs. Total withdrawal from the aquifer has been increasing since at least 1934, when total well discharge was 101,900 ac-ft, and it reached a maximum of about 542,000 ac-ft in 1989. The increasing volume of withdrawals is approaching the aquifer's 1934-1995 average recharge volume of 674,200 ac-ft/year (Brown and Patton 1996). To illustrate the impact of groundwater withdrawals on springflows, Figure 2 shows the discharge hydrograph from Comal Springs during the period of record and Figure 3 shows the discharge from wells and the aquifer recharge for those years. The hydrograph for the springs can be defined in two periods: before and after the drought of record, which resulted in the drying of the springs in 1956. During the first period, pumping and recharge were both significantly lower than during the second period, and discharge levels had relatively small fluctuations. Following the 1956 drought, recharge increased, but not enough to offset the greater increase in pumping. As a result, the frequency and magnitude of fluctuations in Comal Springs' discharge increased substantially, and several declines in discharge extended below the take/jeopardy levels, as described in the Recovery Plan (USFWS 1996) and indicated on Figure 2 by the horizontal lines. Overall, the average discharge from the Comal Springs decreased from 330 cfs for 1934-1949, prior to the drought of record, to 286 cfs for 1957-1996 after the drought when pumping increased.

Because of the anticipated continued population growth in the Edwards aquifer region, and an associated increase in water use, the trend of declining spring discharge will continue if those water needs are met from the Edwards aquifer. Several estimates have been made that project the increase in regional water demand, and the influence of increased pumping on flows from San Marcos and Comal Springs:

* Data from the Bureau of Reclamation (USDI 1972, 1973, 1974) suggested that demands on the Edwards aquifer, even considering a "low" and unlikely rate of growth for this region, will far exceed the recharge to the aquifer (Longley 1975). Given various scenarios of water usage, the Bureau projected that the probability of continuous flow from the San Marcos Springs by the year 2020 was only 50-75 percent certain.

* The Texas Department of Water Resources' estimated water use from the aquifer through the year 2020, and projected a continued increase in demand for well water into the 21st century; much of this demand was estimated to arise in the San Antonio area (TDWR 1977).

* The first detailed computer simulation of flow in the Edwards aquifer (Klemt et al. 1979), with assumptions of full continued development and average hydrologic conditions, projected that continuous flow from the San Marcos Springs would cease around the year 2010.

* Based on his Edwards research, Wanakule (1990) stated: "The present problem facing the Edwards aquifer is the overdrafting of the annual average recharge rate."

* A number of recent studies have modeled springflow at Comal and San Marcos Springs (Texas Water Development Board (TWDB) 1992; McKinney and Watkins 1993) and found that regulation of groundwater withdrawal will be necessary to maintain their continuous flow.

* Population and water use projections developed by the TWDB, Texas Natural Resource Conservation Commission, and the TPWD (1996) show an increase in water demand in the Edwards region that by 2050 will exceed current 1934-1995 mean recharge rates by 43-57%. These figures include consideration for expected water conservation measures.

A special underground water authority (EAA) was recently created, under The Edwards Aquifer Authority Act (EAA Act) (Chapter 626, Laws of the 73rd Texas Legislature, 1993, as amended by Chapter 621, Laws of the 74th Texas legislature, 1995), to manage and issue permits for the withdrawal of groundwater from the Edwards aquifer for the purposes of water conservation and drought management and to make and enforce rules. The Edwards aquifer was found to be a unique aquifer and a distinctive natural resource of this state. It is a complex hydrological system and the sole source of water for a diverse group of social and economic interests. The EAA was designated a special regional management district to protect terrestrial and aquatic life, domestic and municipal water supplies, the operation of existing industries, and the economic development of the state. All reasonable measures are to be taken to conserve water; protect water quality in the aquifer; protect water quality of surface streams provided with springflows from the aquifer; maximize the beneficial use of water available to be drawn from the aquifer; protect aquatic and wildlife habitat; protect threatened and endangered species under federal or state law; and provide for instream uses, bays and estuaries. Under the EAA Act, except as provided under the Critical Period Management Plan, water withdrawals from the aquifer may not exceed 450,000 acre-ft of water for each calendar year for the period ending December 31, 2007. At the beginning of January 1, 2008, the amount of permitted withdrawals from the aquifer may not exceed 400,000 acre-ft of water for each calendar year, and not later than December 31, 2012, continuous minimum springflows of the Comal Springs and San Marcos Springs are to be maintained to protect endangered and threatened species to the extent required by federal law.

Texas also recently passed Senate Bill 1 that states no later than September 1, 2001, and every five years thereafter, a comprehensive state water plan will be adopted that incorporates development, management, and conservation of water resources and preparation for the response to drought conditions, in order that sufficient water will be available at a reasonable cost to ensure public health, safety, and welfare; further economic development; and protect the agricultural and natural resources of the entire state. The goal is to find reasonable and effective ways to involve public participation to establish a reasonable population growth rate compatible with available water resources; estimate water availability, maximize water conservation, develop effective drought and groundwater management plans; protect water

quality, instream flow, and surface waters; enforce water rights and help fund water resource activities.

As part of a February 1, 1993, Judgement (as amended on May 26, 1993) in the case of Sierra Club vs. Secretary of the Interior (No. MO-91-CA-069, U.S. Dist. Ct., W.D. Texas), the Service used its best professional judgement and available information to determine minimum springflows needed to prevent take, jeopardy, or adverse modification to critical habitat of listed species. Determination of take and jeopardy vary from species to species depending on each species' unique requirements, ecology, and life history. In addition, factors associated with the specific action such as magnitude, timing, duration, frequency, and extent also affect a specific take or jeopardy determination. Table 12 contains the Service's determination of minimum springflows necessary to prevent take, jeopardy, or adverse modification of critical habitat for the Edwards aquifer dependent endangered and threatened species (see also USFWS letters dated April 28, 1993 and June 25, 1993).

It may be possible for some of these levels to be reduced under certain conditions, such as with the implementation of an aquifer management plan that significantly influences the magnitude and duration of springflows of Comal and San Marcos Springs combined with control of certain limiting factors such as non-native (exotic) species. Significant control of non-native species would be that which would eliminate threats from species, such as loss or alteration of essential habitat, increased predation, disruption of normal behaviors, or hybridization.

Data gathered by the U.S. Geological Survey (summarized by McKinney and Sharp 1995) show that Comal and San Marcos Springs have little natural variation in water quality. A review of the numbers shows that parameters like temperature, pH, conductivity, total dissolved solids, and major ions generally vary less than 10% and usually less than 5% from the mean. For example, temperature in the San Marcos Springs typically varies less than 0.5°C (32.9° F) in the headwaters and only slightly more at the lower end of the spring run habitat (Guyton & Associates 1979). Vaughan (1986) reported a constant temperature of 21.5°C (70.7° F), with ranges in the streamflow from 25.5°C (77.9° F) in August to 20.4°C (68.7° F) in February at the lower end of the wild-rice zone. Oxygen content reported by Vaughan (1986) was between 5-6 ppm. Springflows tend to be alkaline or neutral, which is typical of limestone aquifers (USFWS 1996). The pH range of the San Marcos Springs was reported as 6.9-7.9 (TWDB 1968; Vaughan 1986). Whiteside et al. (1994) reported the lowest pH levels at 6.3 in the upper portions of the river and up to 7.9 in the lower.

Table 12. U.S. Fish and Wildlife Service determination of minimum springflows needed to prevent take, jeopardy, or adverse modification of critical habitat. All flows rates are given in cubic feet per second (cfs).

Species	Take	Jeopardy	Adv. Mod.
Fountain darter in Comal	200	150	N/A
Fountain darter in San Marcos	100	100	100
San Marcos gambusia	100	100	100
San Marcos salamander	60	60	60
Texas blind salamander	50*	50	N/A
	Damage & Destruction		
Texas wild-rice	100	100	100

*Refers to San Marcos springflow

The U.S. Geological Survey data also show a high drinking water quality for the springflows and aquifer in general. However, there are increasing risks of aquifer, springflow, and streamflow contamination. Pollution threats include:

1) groundwater pollution of the Edwards Aquifer from land-based hazardous material spills and leaking underground storage tanks;

2) cumulative impact of urbanization (road runoff, leaking sewer lines, residential pesticide and fertilizer use, etc.);

3) increased impact of contaminants due to decreased dilution from smaller volumes of water in the aquifer and springflows; and,

4) surface, stormwater, and point and nonpoint source discharges into the streamflows.

Although the aquifer is generally not contaminated to exceed federal drinking water standards, contaminants have been found with greater frequency in the aquifer by the following U.S. Geological Survey reports, and include some wells with pollutant levels that exceed the standards. Reeves (1976) noted the occurrence of fecal coliform and fecal strep bacteria, and elevated nitrate and phosphate levels in some wells on the recharge zone. Most of these sites were near suburban developments. Buszka (1987) found elevated levels of nitrates, bacteria, volatile and nonvolatile organic compounds, and pesticides throughout much of the aquifer, but concentrated near Uvalde and San Antonio. Some of these sites were from a leaking landfill in San Antonio and from another point source contamination site in Uvalde, but many are too far removed to be firmly attributed to those sources and likely reflect other contaminant sources. Roddy (1992) reported similar results and additional contaminant localities. Rice (1994) found that 54 wells in Bexar County have reported mercury and chlorinated solvents. While only a few wells had contaminant levels above those permitted by drinking water

standards, the presence of any compounds found in Edwards wells demonstrates the potential for aquifer contamination. As a result of these and other related factors that threaten aquifer water quality, the Edwards Underground Water District concluded (Kipp.et al. 1993):

"The lack of adequate comprehensive standards and regulatory controls to protect the aquifer against water quality degradation, coupled with the rapid pace of development over the ERZ [Edwards aquifer recharge zone] *at this time, and presumably for some time to come, suggests that degradation of water in the Edwards aquifer is imminent."*

Many of the threats by urbanization to aquifer water quality also threaten spring-based streamflows. Runoff from streets, highways, and commercial and residential landscapes, and potential spills of hazardous materials pose the greatest risks to streamflow quality.

Effects of the Action

One of the major threats to the fountain darter, Texas wild-rice, San Marcos gambusia, San Marcos salamander, Texas blind salamander, Comal springs riffle beetle, Comal springs dryopid beetle, and Peck's cave amphipod is loss of springflows and reductions in aquifer levels. Loss of springflows also results in impacts to critical habitat for the four species that have designated critical habitat.

Flows at San Marcos and Comal Springs are tied directly to water usage from the Edwards aquifer. Use of groundwater in the region decreases flow of water from the springs. The TWDB used their Edwards Balcones Fault Zone flow model to simulate aquifer response to several constant withdrawal pumpage scenarios under various recharge conditions. The model was to examine springflows expected at the San Marcos and Comal Springs under various pumping scenarios. The model's ability to predict springflows on a monthly average at Comal Springs is generally accepted. The model is less accurate in predicting conditions in the San Marcos Springs. The TWDB model shows that at both a 450,000 and a 400,000 ac-ft/year constant pumpage scenarios, in a repeat of the historic recharge record, a high probability of springflow decline resulting in jeopardy to the species remains. In fact, the probability is high that springflows could cease in the Comal Springs for a period of years (Figure 4 and Figure 5). Figure 6 shows that a 140,000 ac-ft constant pumping level would result in a constant flow above 100 cfs at Comal Springs and flows only drop below 200 cfs once during the part of the historic record that corresponds to the most severe drought of record.

The four DOD installations currently rely on the Edwards aquifer as the source of their water. Existing water use levels will be reduced from historic use by transferring a portion of the current Edwards water to reuse water and through conservation practices. The proposed projects include measures to conserve water, to implement reuse measures and analyze the feasibility of expanding reuse lines to other areas of the bases, and reduce reliance on groundwater.

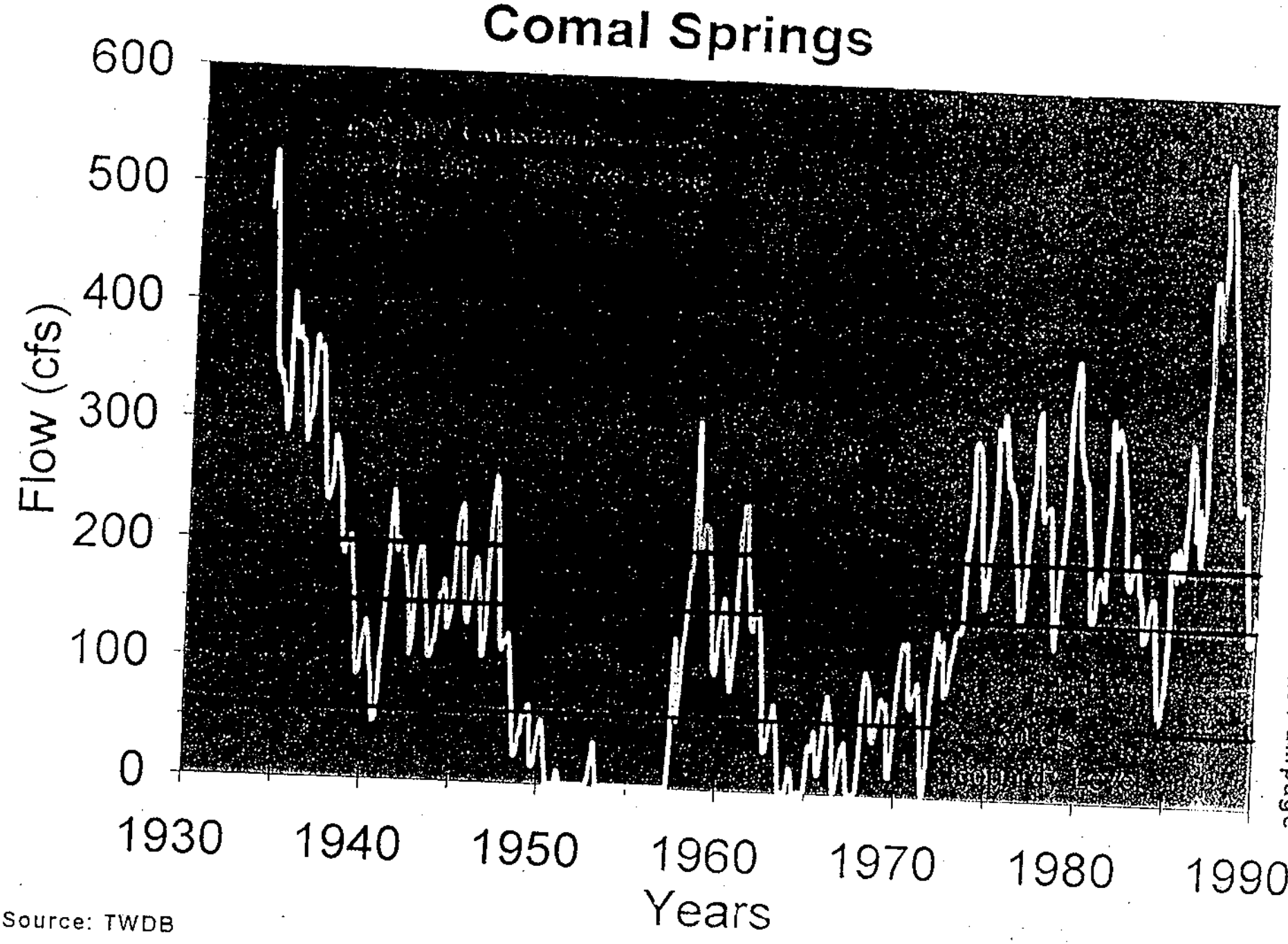
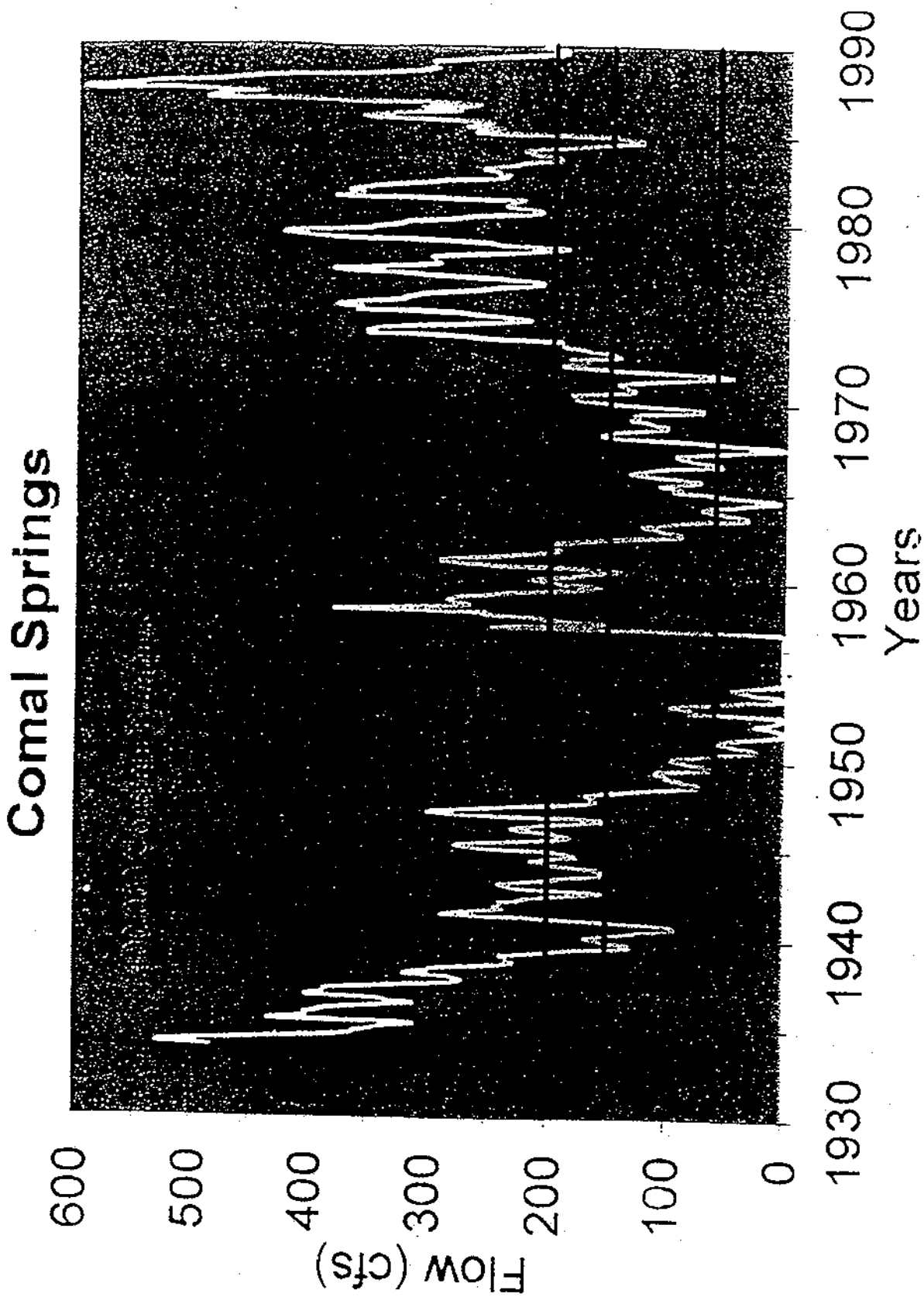


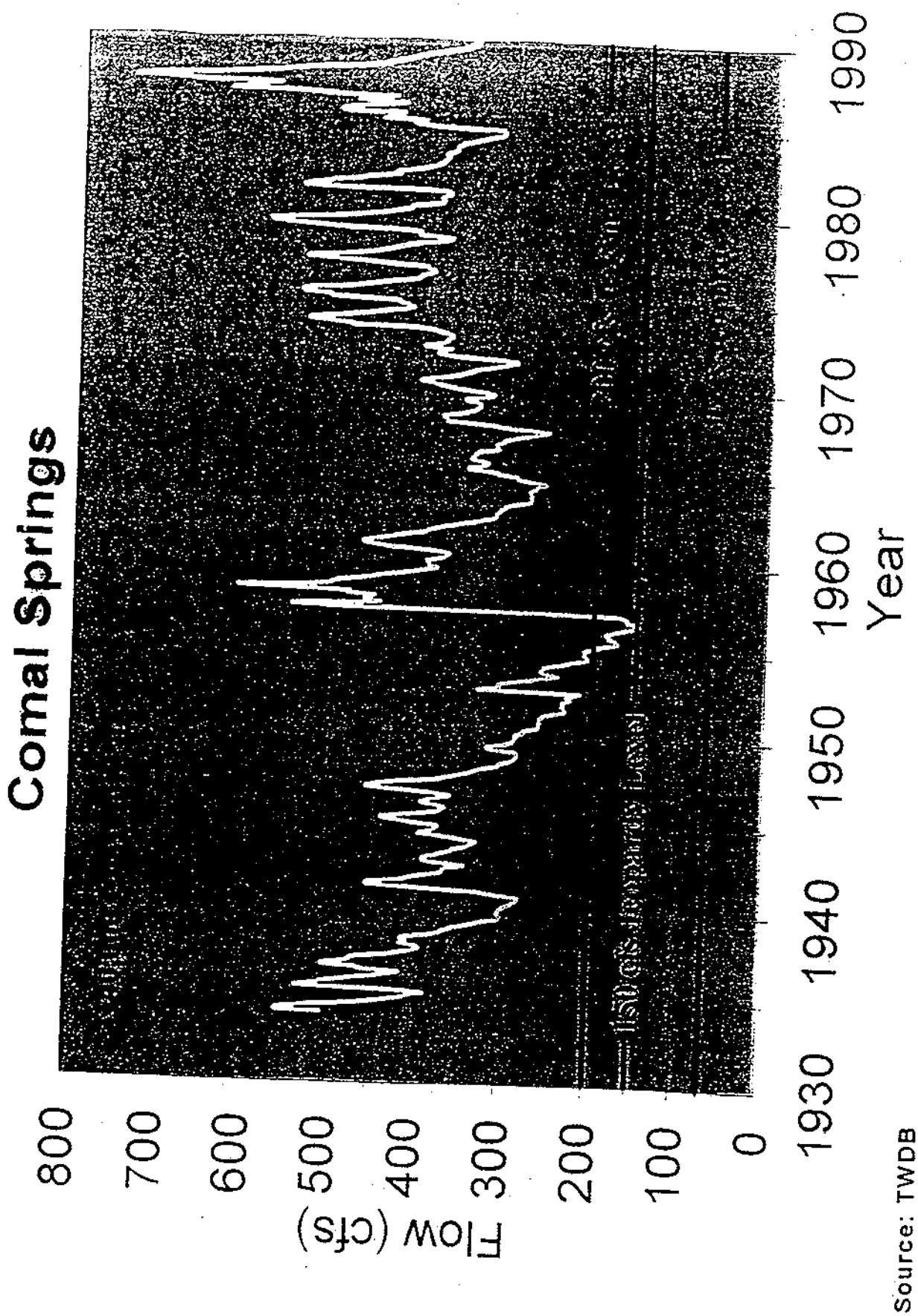
Figure 4. Comal Springs 450,000 Constant Pumpage

Figure 5. Comal Springs 400,000 Constant Pumpage



Source: TWDB

Figure 6. Comal Springs 140,000 Constant Pumpage



Source: TWDB

The greatest threats to water quality are non-point source contamination from spills, urban runoff, construction activities and impurities associated with human activities, particularly in the recharge zone (Seal 1996). As flows and water quantity decrease the spatial distribution of water quality parameters (temperature, pH, turbidity, conductivity, dissolved gases) increase in magnitude in a manner that may have a negative impact on the listed species (Seal & Ellis 1997). The Balcones Fault Zone- San Antonio Region is bounded on the south and east by a saline water interface known as the "bad water" line. Groundwater goes from fresh to saline to brackish. Lowered water levels due to cumulative groundwater pumpage or decreased recharge may result in movement of the saline water line into fresh water sections increasing the potential for impacts to species dependent on freshwater. Lower aquifer levels and springflows may also result in increased concentration of contaminants because less water would decrease the potential for dilution.

The USAF identified 52 IRP sites and 3 AOC's on Kelly AFB as described in the proposed action. Other installations have similar programs looking at contaminant issues and their effect on water quality. Some proposed actions at the installations would also result in impacts to soils, geology, water and biological resources from ground disturbance associated with construction or redevelopment. Airfield-related activities would continue to require the use of aboveground and underground storage tanks for fuels and other hazardous materials.

If contaminants and potential pathways (for example, wells, faults) are not controlled, remediated properly, or monitored regularly contamination may increase and threaten plant and animal species as well as humans. To reduce the impacts of hazardous waste and contamination that may reduce water quality, DOD is committed to continue remediation of all sites by retaining the necessary interests (for example, easements), in order to operate and maintain all remediation and monitoring systems; ensuring that any site-specific land-use limitations are identified and enforced, coordinating IRP activities with the environmental regulators; keeping the community abreast of the IRP activities; and, continuing well maintenance program and implementing remediation.

Kelly AFB water quality impacts are being dealt within the previous consultation (2-15-97-F-039). This biological opinion does not address any water contamination impacts directly to the aquifer from DOD, other than those in the Kelly biological opinion. If any aquifer contamination issues are later identified or expected, DOD will need to consult with the Service further.

Cumulative Effects

Cumulative effects include the effects of future State, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

As the BA and recovery plan state a number of biological factors contribute to the continued risks to the species, including competition between non-native and native plants, introduced species, parasites, recreation, human population growth and development, and runoff; but one of the most significant cumulative impacts is that of groundwater withdrawal from the Edwards aquifer. Groundwater withdrawal has historically been based on a "right of capture." In 1993, the Texas legislature passed the EAA Act creating the Edwards Aquifer Authority with the authority to regulate groundwater withdrawal. Section 1.14 of the EAA Act indicates that authorizations to withdraw water from the aquifer shall be limited in accordance with that section to "protect species that are designated as threatened or endangered under applicable federal or state law" among other purposes. Except as provided in certain exceptions, the amount of withdrawals permitted may not exceed 450,000 ac-ft for each calendar year through December 31, 2007. For the period beginning January 1, 2008 the amount of permitted withdrawals may not exceed 400,000 ac-ft/year. In addition, the Authority "shall implement and enforce water management practices, procedures, and methods to ensure that, not later than December 31, 2012, the continuous minimum springflows of the Comal Springs and the San Marcos Springs are maintained to protect endangered and threatened species to the extent required by federal law." The Authority has been challenged by legal actions questioning EAA's authority, structure and rules. However, the Authority's board began operating in the summer of 1996, and in 1998 issued proposed interim withdrawal permits and began operating the Critical Period Management Plan prescribed in the EAA rules. On 1 December 1998, the 126th District Court (Travis County), invalidated the proposed withdrawal permits and the Critical Period Management Plan. It is expected that EAA will re-adopt rules, and re-issue permits. Under the EAA Act the Authority is also to develop and implement a comprehensive water management plan consistent with Section 1.14. In the interim, several local drought management plans are in operation and local communities have been undertaking some conservation actions including citizens planning groups, seeking alternative water supplies and other efforts. These actions have not been sufficient to decrease water withdrawals to a level that assures conservation of the listed species. In 1996, flows declined into the mid-80 cfs range in the Comal system and mid-70 cfs range in the San Marcos system. Additionally other local threats are likely to continue to occur, some of which will be exacerbated by low flows, further reducing the chances of conservation and recovery of the species.

Conclusion

After reviewing the current status of the fountain darter, Texas wild-rice, San Marcos gambusia, San Marcos salamander, Texas blind salamander, Comal springs riffle beetle, Comal springs dryopid beetle, and Peck's cave amphipod; the environmental baseline for the action area; the effects of ongoing and proposed actions of the four DOD installations (Fort Sam Houston, Kelly, Lackland, and Randolph AFBs) and the cumulative effects; it is the Service's biological opinion that as proposed, this action is not likely to jeopardize the continued existence of these species or to adversely modify designated critical habitat. The actions proposed as a part of this project to reduce reliance on groundwater withdrawal from the Edwards aquifer, implement stringent drought management plans, protect water quality, and fund conservation actions (including refinement of the Edwards aquifer model) will reduce the impacts of the four DOD installation's actions on the species. The Service believes these actions are in proportion to the four DOD installations' overall average historic water use and represent their fair share of reducing those overall impacts over the time covered by this consultation (November 1999 - December 2003). The Service believes the reductions in Edwards aquifer water use from the historical average pumped by the four bases to those identified in this biological opinion represents a reasonable goal for the four DOD installations to meet in the time frame covered by this consultation. However, as evidenced by the figures presented, further water withdrawal reductions will be needed beyond the time frame covered by this consultation to reduce the probability of the species extinctions due to low spring flows to an acceptable-low level (as well as to provide minimum continuous springflows at Comal and San Marcos springs as called for in the EAA Act). It is possible that by December 2003 the EAA may have completed a comprehensive aquifer management plan and habitat conservation plan that can form the basis for a region wide ESA incidental take permit application that will cover water use by the entire region. Federal agencies such as DOD must still comply with section 7(a)(2) consultation requirements of the ESA. The Service will need to determine whether DOD is in compliance with the regional permit. If it is determined that DOD is not covered under the region wide habitat conservation plan and incidental take permit, an individual section 7 consultation may be necessary. We recommend DOD participate or partner in the development of the Habitat Conservation Plan to ensure DOD's coverage.

This non-jeopardy conclusion is based in large part on DOD's commitment to expeditiously reduce their reliance on withdrawals from the Edwards aquifer to an amount not to exceed 11,830 acre-ft/yr for the calendar year 2000 and 2001 and not to exceed 10,515 acre-ft/yr for each calendar year 2002 and each year beyond until the end of the time covered by this consultation, December 31, 2003; and in the interim to take those actions outlined in the description of the proposed action (implementing stringent drought management plans, seeking and using alternative water sources, working with appropriate partners to improve the Edwards aquifer model). These interim actions will increase the species' chances of making it through a repeat episode of temporary low spring flows in the interim before a region wide

management plan is implemented that assures the species are not jeopardized and that critical habitat is not adversely modified.

INCIDENTAL TAKE

Incidental Take

Section 9 of the ESA, and Federal regulation pursuant to section 4(d) of the ESA as amended, prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering. Incidental take is any take of listed animal species that results from, but is not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or the applicant. Under the terms of sections 7(b)(4) and 7(o)(2) of the ESA, taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with an Incidental Take Statement.

The measures described below as reasonable and prudent measures and terms and conditions in this biological opinion are non-discretionary and must be undertaken by DOD so that they become binding conditions of any condition of any grant or permit issued to DOD, as appropriate, in order for the exemption in section 7(o)(2) to apply. DOD and the four installations (Fort Sam Houston, Kelly, Lackland, Randolph) have a continuing duty to regulate the activity covered by this incidental take statement. If DOD and the four installations (1) fail to assume, implement, or adhere to the terms and conditions of the incidental take statement, and/or (2) fail to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, DOD and the four installations must report the progress of the action and its impacts on the species to the Service as specified in the incidental take statement. [50 CFR §402.14(i)(3)]

Even though the Service expects that groundwater withdrawals that are facilitated by the ongoing and proposed actions of DOD's four installations will contribute to incidental take of fountain darters, San Marcos gambusia, and Comal Springs riffle beetle, and possibly Texas blind salamander, San Marcos salamander, Comal Springs dryopid beetle, and Peck's cave amphipod, the best scientific and commercial data available are not sufficient to enable an estimate of a specific amount of incidental take to the species. In instances such as these, the Service has designated the expected level of take as unquantifiable. The Service is willing to provide DOD with an incidental take statement for the Texas blind salamander, San Marcos salamander, Comal springs dryopid beetle, and Peck's cave amphipod because although DOD cannot avoid jeopardizing the species by themselves, because they do not control pumping over

the entire aquifer region the actions described in this BO that DOD has committed to do represent their "fair share" of the overall picture needed to minimize take and avoid jeopardy and reduce the risk of species extinction. Equivalent efforts to reduce withdrawals, and provide springflow for the listed species, and minimize and mitigate any take, and reduce the risk of jeopardizing the species or adversely modifying their critical habitats to low levels is the responsibility of all pumpers. If a habitat conservation plan were developed and implemented by a regional permit applicant designed to avoid jeopardy to all species (a permit requirement) then the take of the Texas blind salamander, San Marcos salamander, Comal Springs dryopid beetle, and Peck's cave amphipod would not likely occur.

Sections 7(b)(4) and 7(o)(2) of the ESA generally do not apply to the incidental take of listed plant species like Texas wild-rice. However, protection of listed plants is provided to the extent that ESA prohibits the removal, reduction to, and possession of Federally listed endangered plants or the malicious damage of such plants on areas under Federal jurisdiction, or the destruction of endangered plants on non-Federal areas in violation of State law or regulation or in the course of any violation of a State criminal trespass law.

This biological opinion does not authorize any form of take that is not incidental to the withdrawal of Edwards aquifer groundwater by the four DOD installations, in the authorized water withdrawal amounts specified and in conjunction with other take minimizing measures described in this biological opinion.

Effect of Take

In this biological opinion, the Service determined that this unquantifiable level of anticipated take from DOD's actions is not likely to result in jeopardy to the fountain darter, Texas wild-rice, San Marcos gambusia, San Marcos salamander, Texas blind salamander, Comal springs riffle beetle, Comal springs dryopid beetle, and Peck's cave amphipod or the destruction or adverse modification of critical habitat for these species.

Reasonable and Prudent Measures

The Service believes that the reasonable and prudent measures presented below are necessary and appropriate to minimize the incidental taking authorized by this biological opinion.

1. Progressively reduce DOD's four installations (Kelly AFB, Fort Sam Houston, Lackland AFB, and Randolph AFB) dependence on Edwards aquifer groundwater within the time frame covered by this consultation (November 1999 to December 2003); implement water conservation measures and other alternative water sources to reduce Edwards aquifer water withdrawals to DOD's fair share of 450,000 acre-ft/yr (that is, 11,830 ac-ft) for the calendar year 2000 and 2001 and not to exceed DOD's fair share of 400,000 acre-ft/yr (that is, 10,515 ac-ft) for calendar year 2002 and each year beyond until the end of the time covered by this consultation, December 31, 2003.

DOD and the four installations will evaluate their performance in achieving the necessary cutbacks in Edwards aquifer use and make the necessary adjustments to meet those levels, and manage and accommodate growth and increased water needs without surpassing these permitted levels.

2. Implement a significant Drought Management Plan on all four DOD installations as outlined in Table 10 at the appropriate J-17 well levels or springflows and evaluate its adequacy. During increasing springflows or aquifer levels, each stage will be in effect for 10 consecutive days unless a more restrictive stage is implemented and will not be rescinded until the 10 day rolling (moving) average of the J-17 index well and springflow levels triggers a less restrictive stage.

3. Partner with the appropriate parties to help develop and refine the Edwards aquifer computer model for technical analysis of the aquifer and springs' responses to various pumping regimes and optimization alternatives. This should assist in avoiding and/or reducing impacts to species and their habitats by improving the ability region-wide to manage for aquifer levels and springflows necessary to avoid jeopardy and minimize take.

4. Actively promote public information and education on water use, quantity, quality, and conservation efforts. Monitor and include in annual report the progress and effectiveness of such programs implemented.

5. Encourage partnerships among the installations and other Edwards aquifer users, such as local, regional, state, and Federal agencies and other private or public entities for cooperative efforts to manage the Edwards aquifer waters in a way that provides for continuous spring flows needed by the endangered and threatened species.

6. Investigate alternative sources of water, particularly for longer-term additional reductions beyond the 4-year life of this biological opinion.

7. All Reasonable and Prudent Measures except for # 1 and 2 of the Kelly biological opinion (#2-15-97-F-039) are still in effect. (Appendix B) Numbers 1 and 2 are recalculated, revised, and considered in this four base biological opinion.

8. Submit all annual reports to U.S. Fish and Wildlife Service, 10711 Burnet Rd., Suite 200, Austin, TX 78758. Annual reports are due on February 28th of each year covered by this biological opinion. The first report will be due 2/28/2000 for part of 1999 covered under this opinion and the last report will be due 2/28/2004 for calendar year 2003.

Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, DOD and the four installations are responsible for compliance with the following terms and conditions, which implement the reasonable and prudent measures described above.

1. DOD will implement water conservation measures and other alternative water sources to reduce the DOD's four installations (Kelly, Fort Sam Houston, Lackland, and Randolph) Edwards aquifer water withdrawals, within the time frame covered by this consultation (November 1999 to December 2003). Withdrawals of all bases combined are not to exceed 11,830 acre-ft/yr for the calendar years 2000 and 2001 and are not to exceed 10,515 acre-ft/yr for calendar year 2002 and each year beyond until the end of the time covered by this consultation, December 31, 2003. DOD and the four installations will evaluate their performance in achieving the necessary cutbacks in Edwards aquifer use and make the necessary adjustments to meet those levels. Management must accommodate for growth and increased water needs without surpassing these permitted levels. Future needs for additional water may be accommodated through such mechanisms as purchasing or leasing water rights from others, using reuse water, and seeking alternative water sources. Construction, intra- or inter-water basin water transfers or other activities associated with potential future mechanisms for decreasing Edwards aquifer withdrawals may result in impacts to endangered species. Therefore, each project will need to be evaluated separately for impacts to federally listed species and determinations made whether these mechanisms and/or projects are in compliance with the ESA and if re-consultation would be necessary. If DOD or the four installations covered by this consultation fail to demonstrate satisfactory progress (as determined by the Service and/or not meeting these targets) toward reducing pumping demands on the Edwards aquifer, DOD will reinitiate formal consultation with the Service.

2. Implement a significant Drought Management Plan on all four bases as outlined in Table 10 and evaluate its adequacy. If after the specified number of days the springflow (cfs) level has dropped to or below the Service's recommended trigger level, but the J-17 well level has not triggered the respective stage, then the cfs springflow level will supercede the J-17 index well aquifer level as a trigger and the next stage will be implemented. Each stage will be in effect for 10 consecutive days unless a more restrictive stage is implemented and will not be rescinded until the 10 day rolling (moving) average of the J-17 index well and springflow levels triggers a less restrictive stage. To meet Stage V reductions, future non-discretionary water demand from the aquifer should not exceed that necessary to meet Stage V limits. Monitor the effectiveness of the drought management plan and include in the annual report to the Service.

3. Partner with the appropriate parties and contribute $262,877.00 to the development and/or refinement of the Edwards aquifer computer model so that the model provides a more accurate tool for predicting springflows based on various aquifer levels and aquifer management scenarios and coordinate with the Service and EAA throughout the process. The model should be more user-friendly and readily available for use by those involved in aquifer management, or assessment of effects of pumping and or aquifer management alternatives. For further information refer to the study recommended by the Technical Advisory Group titled Modflow Computer Model/GIS Data Sets. The project will be initiated and funds made available no later than twelve (12) months after issuance of this BO. Progress should be reported in the annual report to the Service and at completion of the project.

4. Design and implement a voluntary program or partner with EAA, SAWS, and/or other organizations to educate and assist employees achieve water conservation on base and off base at personal residences. Such program activities could include information on such things as retrofitting with low flow toilets and shower heads or xeriscaping.

5. DOD and the four installations will work with other aquifer users and participate in regional aquifer management planning to develop a comprehensive approach to aquifer management that avoids jeopardizing the species and avoids adversely-modifying their critical habitat and minimizes and mitigates negative impacts to the species and their ecosystems as much as possible. Progress will be summarized in the annual report to be submitted February 28th of each year covered by this biological opinion.

6. Investigate and partner with appropriate parties to find alternative sources of water that will yield longer-term, additional reductions of water beyond the life of this biological opinion.

7. All Reasonable and Prudent Measures except for #1 and 2 and all Terms and Conditions except for # 2, 4, 5, and 12 of the Kelly biological opinion (2-15-97-F-039) are still in effect (Appendix B). Terms and Condition numbers 2, 4, 5, and 12 have been recalculated, revised and considered in this four base biological opinion.

8. DOD will submit annual reports informing the Service of progress made to meet the Reasonable and Prudent Measures and Terms and Conditions set forth in this biological opinion and the effectiveness of those activities for the length of the permit. The reports should include total annual water withdrawal for each of the four installations, broken down on a monthly basis. The report should also include discussion of the public outreach program, progress on refined Edwards aquifer model, progress on funding and implementing measures to reduce Edwards water use, and the Drought Management Plan to show necessary progress and effectiveness of implemented measures to prevent jeopardy to the species and minimize impacts to the species during times of drought and low spring flows. Annual reports should be sent to the U.S. Fish

and Wildlife Service, 10711 Burnet Rd., Suite 200, Austin, TX 78758 and due February 28th of each year covered by this biological opinion.

9. DOD will submit the report required by the Kelly AFB biological opinion combined with that required by Term and Condition # 8 of this four base biological opinion. This report should include discussion of the IRP remediation effort at Kelly AFB, Edwards well monitoring program, and any other water quality issues.

10. DOD will maintain responsibility for assuring these terms and conditions and measures are accomplished during the time frame covered by this consultation. If EAA completes a comprehensive aquifer management plan and habitat conservation plan that can form the basis for a region wide ESA incidental take permit application that will cover water use by the entire region the Service will determine whether DOD is in compliance with the regional permit. If it is determined that DOD is not covered under the region wide habitat conservation plan and incidental take permit, an individual section 7 consultation will be necessary regarding impacts to the listed species and their critical habitats from any continued DOD Edwards aquifer water use beyond the time frame covered by this consultation.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. The term conservation recommendations has been defined as Service suggestions regarding discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or develop information. The Service makes these conservation recommendations:

1. Further reduce water dependency beyond the levels set in this biological opinion. (Task 2.31 of Recovery Plan)

2. Provide extra protective measures for aquifer-dependent species either by contributing directly to projects on the Edwards aquifer project list (Appendix A) or by contributing to a Conservation Fund set up for the conservation of these species. (Task 2.31 of Recovery Plan)

3. Assist in identifying and sampling Edwards wells that may be causing entrainment of two species of blind catfish (two unlisted species of concern, which could become candidates for listing) and consider them for closure and/or assist in developing a method for preventing entrainment.

4. Assist with habitat and flow requirement studies of the listed species as needed (may include such things as assisting in fieldwork, or flying over and taking aerial photographs to monitor vegetation). (Task 1.15 in Recovery Plan)

5. Study of recharge enhancement potential on base, including effects on water quality and native fauna in recharge features.

6. Take samples of sediments in recharge features and check for contaminants.

7. Contribute to captive propagation efforts.

8. Provide mechanical and technical assistance in the modification and/or repair of Cape's Dam (and possibly others) on the San Marcos river so that they are modified to manage water in the river in such a way that best provides for the species and their habitats.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION

This concludes formal consultation on the ongoing and proposed actions at four DOD installations. Reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained and if: 1) DOD and the four installations fail to demonstrate progress toward reducing pumping demands on the Edwards aquifer; 2) Edwards aquifer water withdrawals exceed those outlined in the reasonable and prudent measures; 3) information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this biological opinion. An example here would be if EAA did not meet its legal mandates for regulating aquifer withdrawals as discussed in the Cumulative Effects section of this opinion, in which case the cumulative effects would be greater than considered in this opinion; 5) the agency action is subsequently modified in a manner that causes an effect to a listed species or critical habitat that was not considered in this biological opinion; or 6) a new species is listed or critical habitat designated that may be affected by this action (50 CFR 402.16).

In future communications on this project, please refer to consultation number 2-15-98-F-759. If we may be of further assistance, please contact Mary Orms, Alisa Shull, or me at (512/490-0057).

Sincerely,

William Seawell
for

David C. Frederick
Supervisor

Attachments

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Appendix A.

Edwards Aquifer Projects

Edwards Aquifer Projects

The Service has expressed concern that the deterioration of water quality and/or the combined current level of water withdrawal for all consumers from the Edwards Aquifer adversely affects aquifer-dependent species located at Comal and San Marcos Springs under low flow conditions. The main actions necessary to avoid jeopardy to these species and minimize take from aquifer withdrawals are those measures necessary to assure adequate springflows for the listed species. However, the Service recognizes that to put sufficient measures in place to assure those spring flows will take time. Therefore, while expeditious progress needs to be made to put measures in place to assure adequate springflows, in the meantime, measures will be needed to minimize take and increase the species' chances of making it through low flows and recovering from impacts. The attached menus include very abbreviated explanations of projects that can be considered by parties involved in Section 7 consultations and/or Section 10 (a)(1)(B) Habitat Conservation Plans to meet part of the requirements for minimizing and/or mitigating take, monitoring, adaptive management, and other measures that would benefit conservation. Monitoring and adaptive management provisions should be included as part of any HCP for Edwards Aquifer dependant species. Some of this work has been initiated, but additional work and funding is needed to complete. The Service should be consulted for further details. Each project on this list has been assigned a point value (based primarily on relative cost). The total of all of these points = 10,000.

Menu A. Additional measures to minimize and mitigate take

The items in Menu A. are focused primarily on reducing take during low flows and mitigating take through restoration efforts. Some items represent projects to fill information gaps to better manage (1) springflows so that adequate springflows can be provided, (2) impacts to species during low flows to further reduce those impacts, (3) restoration efforts, increasing their likelihood of success.

1a. Research on Restoration and Reintroduction of Texas wild-rice (150 pts.)

- research is needed to develop and test specific habitat restoration and reintroduction techniques for Texas wild-rice

1b. Reintroduction, restoration, and management of Texas wild-rice (215 pts.)

- aimed at increasing total areal coverage of wild-rice to increase the chances of making it through short periods of low flow and decrease the proportion of the population affected

2a. Restoration of aquatic vegetation (150 pts.)

- techniques must be developed and tested for habitat restoration

2b. **Vegetation restoration after low flow events** (200 pts.)

- aimed primarily at restoring habitat for fountain darters and their prey base

3. **What causes vegetation loss during low flow?** (303 pts.)

- research to determine cause(s) of vegetation loss, devise management methods to prevent it if possible, and assist in developing restoration techniques to promote vegetation recovery.

4a. **Control structure repair/modification** (350 pts.)

- modification and/or repair of a number of water control structures (such as low water dams) to improve the ability to move water to those areas that have the best remaining habitat as flows decline.

4b. **Improve water control structures and optimize management** (50 pts.)

- in some cases additional research may be necessary to determine optimum redesign of structure

5. **Captive propagation** (5,147 pts.)

- for restoration work a good genetically representative captive stock is needed
- research is needed to develop reliable captive breeding and reintroduction protocols
- equipment needs
- operation needs

6. **Genetic diversity and distribution information** (225 pts.)

- this information for wild populations is critical to a number of management concerns, impact assessments, and mitigation design

7. **Control and management of exotic plant species** (50 pts.)

- develop and test techniques to remove and possibly replace invasive exotic aquatic plants that are increasing at the expense of Texas wild-rice or other native plant species and that could hamper restoration efforts

Information gaps

1. GIS localities for Texas wild-rice (15 pts.)

2. Parasites

   a. Active management needed to address the impact to fountain darter's condition (200 pts.)
   b. Parasite life history, population dynamics, and management research (200 pts.)

3. Physiological requirements of Texas wild-rice (100 pts.)

4. Texas wild-rice conditions for sexual reproduction (100 pts.)

5. More accurate model (hydraulic) of San Marcos (150 pts.)

   - This model will help design and evaluate management options related to effects on surface habitat such as water depths and velocities. For example, it could be used to assess potential habitat available for Texas wild-rice under various flows, information useful for planning reintroduction efforts.

6. More accurate Edwards Aquifer model to predict springflows (200 pts.)

7. Improve knowledge of the geohydrology in the San Marcos region (1,000 pts.)

   - additional information is needed on flow paths, flow barriers, and regional/local recharge and discharge features

Impacts of snails and other exotic species and development of control techniques (540 pts.)

Additional water withdrawal reductions

Funds may also be put in reserve to be used to purchase or lease water rights to reduce withdrawals below required cutback levels from those who are in compliance with required cutback levels.

Menu B. Monitoring

1. Species and habitat monitoring (325 pts.)

2. Improve ability to accurately monitor flows

   a. improve accuracy of USGS gage just below Spring Lake (80 pts.)

b. establish discharge monitoring (gage) on old (original) channel of Comal River (175 pts.)

c. establish a monitor well in San Marcos to correlate aquifer level and springflow (75 pts.)

Menu C. Optional Items

These items may provide a conservation benefit to the species and/or their habitat, and in some cases may influence flow requirements and/or impacts to the species during low flows.

1. **Exotic (non-native) and predator species control** (1,250 pts.)

2. **Relationship of stage/head of spring Lake to San Marcos springs discharge, particularly at low aquifer levels** (30 pts.)

3. **Floating mats of vegetation** (36 pts.)

   - involves both a program of reducing mats (through better vegetation management) and active, but careful, removal of mats that form in the San Marcos River system; may also be needed in Comal River system

4. **Improve local water quality (surface and nearby recharge)** (500 pts.)

   - may include identifying sources of pollutants from site-specific areas (including surface and subsurface sources of pollutants) and assisting in developing and implementing comprehensive watershed management plans (particularly in the local San Marcos and New Braunfels areas), mechanisms for addressing pollutants

6. **Rivers Recreation Master Plan - develop and implement** (200 pts.)

7. **Recreational impacts and management options** (125 pts.)

   - additional studies are needed to further delineate direct and indirect recreational impacts on the listed species

8. **Work with adjacent landowners to reduce threats** (70 pts.)

   - landowner education program to inform and request their cooperation in implementing best management practices to protect and improve river conditions; could include pesticide and herbicide use, wastewater system conditions, bank erosion, aquatic plan management, recreational practices, etc.

Annual Water Allocation by Installation
Non-Drought Conditions

BASE	EAA Permits Ac-ft/yr	Percent of DoD Total	Current FWS Cap Ac-ft/yr	Future FWS Cap Ac-ft/yr
FSH	3,689.442	30.08	3,558.694	3,163.117
Kelly	3,514.647	28.66	3,390.094	3,013.258
Lackland	3,729.814	30.41	3,597.636	3,197.729
Randolph	1,330.735	10.85	1,283.576	1,140.896
Total	12,664.638	100.00	11,830.000	10,515.000

Appendix B

Excerpts from Kelly AFB Biological Opinion (2-15-97-F-039).

beetle, Comal springs dryopid beetle, and Peck's cave amphipod or the destruction or adverse modification of critical habitat for these species.

Reasonable and Prudent Measures

The Service believes that the reasonable and prudent measures presented below are necessary and appropriate to minimize the incidental taking authorized by this biological opinion.

1. Reduce Kelly AFB's dependence on Edwards aquifer groundwater to 2,700 ac-ft/yr beginning in calendar year 1999, and 2,200 ac-ft/yr beginning in calendar year 2002. The USAF will evaluate (on at least an annual basis) its performance in achieving the necessary cutbacks in Edwards aquifer dependency and make the necessary adjustments to meet those levels. Management must accommodate for growth and increased water needs without surpassing these permitted levels. Future needs for additional water may be accommodated through such mechanisms as purchasing or leasing water rights from others. These mechanisms must, however, be evaluated separately for impacts to endangered species.

   If EAA issues a water withdrawal permit for Kelly AFB and it is different from the levels described above, the USAF may request reinitiation of this consultation if they would like the Service to evaluate whether replacing their EAA permit levels with these would be in compliance with Section 7 of the ESA.

2. Contribute $200,000 to the National Fish and Wildlife Foundation (or other foundation mutually acceptable to the USAF and the Service). Monies in the fund will be used, along with contributions from other aquifer users, to help fund such things as mechanisms to improve the condition of the species and the habitat; meet information needs that will help in developing future management options, evaluating impacts, and evaluating the success of ongoing management; captive propagation programs; or/and a contingency fund.

3. Protect water quality through monitoring programs, implementation of contingency plans, remediation activities, and regular review of effectiveness and success of such plans and programs.

4. Actively promote public information and education on water use, quantity, quality, and conservation efforts.

5. Encourage partnerships among USAF and other Edwards aquifer users, such as local, regional, state, and federal agencies and other private or public entities for cooperative efforts to manage the Edwards aquifer waters.

Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the USAF and GKDC are responsible for compliance with the following terms and conditions, which implement the reasonable and prudent measures described above.

1. The USAF and GKDC will work with other aquifer users and participate in regional aquifer management planning to develop a comprehensive approach to aquifer management that avoids jeopardizing the species and avoids adversely modifying their critical habitat. Progress will be summarized in the annual report called for in item 5 below.

2. Within the next two years, the USAF will implement conservation measures and other alternative water sources to reduce Kelly AFB's Edwards aquifer water withdrawals to no more than 2,700 ac-ft/yr beginning in calendar year 1999 and 2,200 ac-ft/yr beginning in calendar year 2002. The USAF will be responsible for apportioning the total water use figures between the various components of the realigned areas (for example between GKDC and Lackland AFB). If USAF or GKDC fails to demonstrate satisfactory progress (as determined by the Service) toward reducing pumping demands on the Edwards aquifer, the USAF will reinitiate formal consultation with the Service.

3. Techniques and/or alternatives used to achieve specified water reductions in item 2 above must be evaluated to determine if they have any impacts on these or any other listed species. If they do and those impacts have not been considered in this biological opinion, then those impacts will need to be addressed in a separate Section 7 consultation.

4. Contribute $200,000 to a Conservation Fund administered by National Fish and Wildlife Foundation (or other foundation mutually acceptable to the USAF and the Service). Contributions will be used to fund such things as mentioned in item 2 of the Reasonable and Prudent Measures and that are consistent with the Recovery Plan for these species. Some examples of such projects may include but are not limited to exotic and predator species control, control structure repair/modification, fountain darter parasite research, vegetation restoration, and entering historic stand localities of wild-rice into a geographic information system. In an effort to enhance the capability to accomplish the highest priority needs and for adaptive management to address unforeseen circumstances, or the development of new information which may dictate new priorities, the funding priorities will be decided by the Service. The USAF will make the contribution no later than twelve (12) months after receiving notification from the Service that the fund manager is in place and a list of projects being considered for funding.

5. Annual reports informing the Service of progress made to meet the terms and conditions set forth in this biological opinion and/or effectiveness of those programs for the length of the permit. The reports should include total annual water withdrawal of Kelly AFB, broken down on a monthly basis. The report may also include discussion of the IRP remediation effort, public outreach, Edwards well monitoring program, and the development or implementation of contingency, water conservation and drought management plans as necessary to show progress during reporting period. Annual reports should be sent to the U.S. Fish and Wildlife Service, 10711 Burnet Rd. Suite 200, Austin, Texas 78578.

6. Continue remediation of IRP sites in accordance with state and federal regulations to prevent further contamination of the shallow groundwater and soils and migration of contaminants into the deeper aquifer and or surface waters. The USAF will acquire all necessary easements or sites to ensure the remediation efforts and monitoring programs will continue after the expiration of this permit until all sites are fully remediated.

7. Cooperate with and participate in an Edwards well monitoring group and program with the EAA, City of San Antonio, SAWS, Bexar Metropolitan Water District and other parties to acknowledge, identify and monitor the integrity of Edwards aquifer wells in the San Antonio area to protect water quality. If programs are not active, the USAF will take reasonable steps to facilitate such efforts.

8. Continue Edwards well monitoring program on the base to identity faulty wells, or wells that need to be retired. Monitor on-base Edwards wells that have potential to allow communication between IRP sites and AOCs and the Edwards aquifer and include findings in the annual report to the Service. Cooperative efforts with water purveyors or individual owners should be undertaken to assure Edwards wells identified to be within a plume of contamination originating on Kelly AFB and outside the base boundary have not been contaminated and are not impacting human health and the environment.

9. Hazardous Material and Waste Spill Contingency plans will be developed, improved or modified as necessary and required by state and federal regulations to ensure water quality of surface and subsurface waters.

10. Continue and facilitate active public outreach program to inform and educate surrounding neighborhoods near contaminated sites of ongoing remediation efforts, potential hazards, and successfully completed remediations.

11. Design and implement a voluntary program or partner with EAA, SAWS and/or other organizations to educate and assist employees achieve water conservation off base at personal residences. Such program activities could include information on retrofitting with low flow toilets and shower heads or xeriscaping.

12. Implement the Water Conservation and Drought Management Plan for Kelly AFB (1996). The plan would prescribe specific demand reduction measures and the associated Edward aquifer level at which they occur and be flexible enough to respond to further reductions during a drought crises. Modify, if necessary, to ensure compliance with any existing and future aquifer management plan(s) that may be implemented by the EAA, state, or Service in response to concerns over threatened and endangered species.

13. The USAF will maintain responsibility for assuring these terms and conditions and measures are accomplished during this 5½-year time frame.. GKDC (possibly in partnership with other entities) will be responsible for working with the Service to obtain the necessary ESA permits for any continued Edwards aquifer water use beyond the 5½-year timeframe. To avoid a lapse in coverage for incidental take under the ESA, GKDC will begin working with the Service to prepare their permit application well before the end of the 5½-year time frame.

CONSERVATION RECOMMENDATIONS

Sections 2(c) and 7(a)(1) of the ESA direct Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. The term conservation recommendations has been defined as Service suggestions regarding discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or develop information. The Service makes these conservation recommendations:

1. Further reduce water dependency beyond the levels set in this permit for the first five years. (Task 2.31 of Recovery Plan)

2. Provide extra protective measures for aquifer-dependent species of concern by further contributions to the Conservation Fund. (Task 2.31 of Recovery Plan)

3. Assist in identifying and sampling Edwards wells that may be causing entrainment of blind catfish and consider them for closure and/or assist in developing a method for preventing entrainment.

4. Assist co-sponsoring and contributing $50,750 to the Conservation Breeding Specialist Group to continue Edwards aquifer workshop series.

5. Assist with Habitat and Flow requirements studies as needed (may include such things as assisting in fieldwork, or flying over and taking aerial photographs to monitor vegetation). (Task 1.15 in Recovery Plan)

APPENDIX C

CORRESPONDENCE WITH THE U.S. FISH AND WILDLIFE SERVICE

AND

THE TEXAS PARKS AND WILDLIFE DEPARTMENT

The Environmental Company, Inc.

2496 Old Ivy Road • Suite 300
Mailing Address: P.O. Box 5127
Charlottesville, Virginia 22905
(804) 295-4446 • Fax (804) 295-5535
Internet: www.tecinc.com

June 28, 2001

Mr. Rotary Green
Natural and Cultural Resources Branch
Environmental Division
Fort Sam Houston, Texas

Dear Mr. Green,

RE: Texas Rare Species for Bexar and Comal Counties, Texas

In response to a telephonic request for an updated list of threatened or endangered species in Bexar and Comal Counties, Texas, Ms. Celeste Brancel-Brown of the Texas Parks and Wildlife Department provided the attached list by e-mail. She indicated that these lists were the most current versions available. The Comal County list was last updated on June 27, 2000 and the Bexar County list was last updated on December 29, 2000.

Sincerely,

Craig Vanderhoef
Project Manager

Attachment:
TPWD Special Species Lists

Vanderhoef, Craig

From: Celeste Brancel-Brown
Sent: Thursday, June 28, 2001 4:02 PM
To: 'Craig Vanderhoef'
Subject: county lists

Mr. Vanderhoef:

Attached are the most current TPWD special species lists for Comal and Bexar counties to assist your preparation of environmental documentation for National Environmental Policy Act compliance. If they do not open or are not attached, please e-mail me your fax number. For your future reference, also attached is an outline identifying the information TPWD needs included in any documentation in order to provide a thorough site-specific review for potential endangered species impacts.


bexar.doc


comal.doc


projformWord95.doc

Celeste Brancel-Brown
Environmental Review Coordinator
TPWD, Habitat Assessment Program
Threatened and Endangered Species
3000 South IH 35, Suite 100
Austin, TX 78704

BEXAR COUNTY

	Federal Status	State Status
***** AMPHIBIANS *****		
Black Spotted Newt (*Notophthalmus meridionalis*) - can be found in wet or sometimes wet areas, such as arroyos, canals, ditches, or even shallow depressions; aestivates in the ground during dry periods; Gulf Coastal Plain south of the San Antonio River		T
Comal Blind Salamander (*Eurycea tridentifera*) - endemic; semi-troglobitic; found in springs and waters of caves in Bexar and Comal counties		T
Edwards Plateau Spring Salamanders (*Eurycea sp. 7*) - endemic; troglobitic; springs, seeps, cave streams, and creek headwaters; often hides under rocks and leaves in water; Edwards Plateau, from near Austin to Val Verde County		
***** ARACHNIDS *****		
Government Canyon Cave Spider (*Neoleptoneta microps*) - small, eyeless, or essentially eyeless spider; karst features in north and northwest Bexar County	LE	
Madla's Cave Spider (*Cicurina madla*) - small, eyeless, or essentially eyeless spider; karst features in north and northwest Bexar County	LE	
Robber Baron Cave Harvestman (*Texella cokendolpheri*) - small, eyeless harvestman; karst features in north and northwest Bexar County	LE	
Robber Baron Cave Spider (*Cicurina baronia*) - small, eyeless, or essentially eyeless spider; karst features in north and northwest Bexar County	LE	
Veni's Cave Spider (*Cicurina venii*) – small, eyeless, or essentially eyeless spider; karst features in north and northwest Bexar County	LE	
Vesper Cave Spider (*Cicurina vespera*) - small, eyeless, or essentially eyeless spider; karst features in north and northwest Bexar County	LE	
***** BIRDS *****		
American Peregrine Falcon (*Falco peregrinus anatum*) - potential migrant; nests in west Texas	DL	E
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - due to similar field characteristics, treat all Peregrine Falcons as federal listed Endangered; potential migrant	DL	T
Black-capped Vireo (*Vireo atricapillus*) - oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces; requires foliage reaching to ground level for nesting cover; return to same territory, or one nearby, year after year; deciduous & broad-leaved shrubs & trees provide insects for feeding; species composition less important than presence of adequate broad-leaved shrubs, foliage to ground level, & required structure; nests mid April-late summer	LE	E
Golden-cheeked Warbler (*Dendroica chrysoparia*) - juniper-oak woodlands; dependent on Ashe juniper (also known as cedar) for long fine bark strips, only available from mature trees, used in nest construction; nests placed in various trees other than Ashe juniper; only a few mature junipers or nearby cedar brakes can provide the necessary nest material; forage for insects in broad-leaved trees & shrubs; nests late March-early summer	LE	E
Henslow's Sparrow (*Ammodramus henslowii*) - wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking		
Mountain Plover (*Charadrius montanus*) - nonbreeding-shortgrass plains and fields, plowed fields (bare, dirt fields), and sandy deserts; primarily insectivorous	PT	

	Federal Status	State Status
White-faced Ibis (*Plegadis chihi*) – prefers freshwater marshes, sloughs, and irrigated rice fields, but can be found in brackish and saltwater habitats		T
Whooping Crane (*Grus americana*) – potential migrant	LE	E
Wood Stork (*Mycteria americana*) – forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960		T
Zone-tailed Hawk (*Buteo albonotatus*) - arid open country, including open deciduous or pine-oak woodland, mesa or mountain country, often near watercourses, and wooded canyons and tree-lined rivers along middle-slopes of desert mountains; nests in various habitats and sites, ranging from small trees in lower desert, giant cottonwoods in riparian areas, to mature conifers in high mountain regions		T
***** FISHES *****		
Guadalupe Bass (*Micropterus treculi*) – endemic; headwater, perennial streams of the Edward's Plateau region		
Toothless Blindcat (*Trogloglanis pattersoni*) – troglobitic, blind catfish endemic to the San Antonio Pool of the Edward's Aquifer		T
Widemouth Blindcat (*Satan eurystomus*) – troglobitic, blind catfish endemic to the San Antonio Pool of the Edward's Aquifer		T
***** INSECTS *****		
A Ground Beetle (*Rhadine exilis*) - small, essentially eyeless ground beetle; karst features in north and northwest Bexar County	LE	
A Ground Beetle (*Rhadine infernalis*) – small, essentially eyeless ground beetle; karst features in north and northwest Bexar County	LE	
Helotes Mold Beetle (*Batrisodes venyivi*) - small, eyeless mold beetle; karst features in north and northwest Bexar County	LE	
Maculated Manfreda Skipper (*Stallingsia maculosus*) - most skippers are small and stout-bodied; name derives from fast, erratic flight; at rest most skippers hold front and hind wings at different angles; skipper larvae are smooth, with the head and neck constricted; skipper larvae usually feed inside a leaf shelter and pupate in a cocoon made of leaves fastened together with silk		
***** MAMMALS *****		
Cave Myotis Bat (*Myotis velifer*) – colonial and cave-dwelling; also roosts in rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (*Hirundo pyrrhonota*) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum cave of Panhandle during winter; opportunistic insectivore		
Plains Spotted Skunk (*Spilogale putorius interrupta*) - catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		

	Federal Status	State Status

*** MOLLUSKS ***

Mimic Cavesnail (*Phreatodrobia imitata*) – subaquatic; only known from two wells penetrating the Edwards Aquifer

*** REPTILES ***

Cagle's Map Turtle (*Graptemys caglei*) – endemic; Guadalupe River System; short stretches of shallow water with swift to moderate flow and gravel or cobble bottom, connected by deeper pools with a slower flow rate and a silt or mud bottom; gravel bar riffles and transition areas between riffles and pools especially important in providing insect prey items; nest on gently sloping sand banks within ca. 30 feet of water's edge — C1

Indigo Snake (*Drymarchon corais*) – Texas south of the Guadalupe River and Balcones Escarpment; thornbush-chaparral woodlands of south Texas, in particular dense riparian corridors; can do well in suburban and irrigated croplands if not molested or indirectly poisoned; requires moist microhabitats, such as rodent burrows, for shelter — State: T

Keeled Earless Lizard (*Holbrookia propinqua*) – coastal dunes, barrier islands, and other sandy areas; eats insects and likely other small invertebrates; eggs laid underground March-September (most May-August)

Spot-tailed Earless Lizard (*Holbrookia lacerata*) - central & southern Texas and Adjacent Mexico; oak-juniper woodlands & mesquite-prickly pear associations; eggs laid underground; eats small invertebrates

Texas Garter Snake (*Thamnophis sirtalis annectens*) - wet or moist microhabitats are conducive to the species occurrence, but is not necessarily restricted to them; hibernates underground or in or under surface cover; breeds March-August

Texas Horned Lizard (*Phrynosoma cornutum*) - open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September — State: T

Texas Tortoise (*Gopherus berlandieri*) – open brush with a grass understory is preferred; open grass and bare ground are avoided; when inactive occupies shallow depressions at base of bush or cactus, sometimes in underground burrows or under objects; longevity greater than 50 years; active March-November; breeds April-November — State: T

Timber/Canebrake Rattlesnake (*Crotalus horridus*) - swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto — State: T

*** VASCULAR PLANTS ***

Big red sage (*Salvia penstemonoides*) endemic; moist to seasonally wet clay or silt soils in creekbeds and seepage slopes of limestone canyons; flowering June-October

Bracted twistflower (*Streptanthus bracteatus*) – endemic; shallow clay soils over limestone, mostly on rocky slopes, in openings in juniper-oak woodlands; flowering April-May

Correll's false dragon-head (*Physostegia correllii*) - wet soils including roadside ditches and irrigation channels; flowering June-July

Elmendorf's onion (*Allium elmendorfii*) – endemic; deep sands derived from Queen City and similar Eocene formations; flowering April-May

Park's jointweed (*Polygonella parksii*) – endemic; deep loose sands of Carrizo and similar Eocene formations, including disturbed areas; flowering spring-summer

	Federal Status	State Status

Sandhill woolywhite (*Hymenopappus carrizoanus*) - endemic; open areas in deep sands derived from Carrizo and similar Eocene formations, including disturbed areas; flowering late spring-fall

South Texas rushpea (*Caesalpinia phyllanthoides*) – Tamaulipan thorn shrublands or grasslands on very shallow sandy to clayey soil over calcareous rock outcrops and caliche hills; flowering in spring

LE,LT - Federally Listed Endangered/Threatened
PE,PT - Federally Proposed Endangered/Threatened
E/SA,T/SA - Federally Endangered/Threatened by Similarity of Appearance
C1 - Federal Candidate, Category 1; information supports proposing to list as endangered/threatened
DL,PDL - Federally Delisted/Proposed Delisted
E,T - State Endangered/Threatened
"blank" - Rare, but with no regulatory listing status

Species appearing on these lists do not all share the same probability of occurrence. Some species are migrants or wintering residents only, or may be historic or considered extirpated.

COMAL COUNTY

	Federal Status	State Statu
***** AMPHIBIANS *****		
Cascade Caverns Salamander (*Eurycea latitans*) - endemic; subaquatic; springs and caves in Comal, Kendall, and Kerr counties;		T
Comal Blind Salamander (*Eurycea tridentifera*) - endemic; semi-troglobitic; found in springs and waters of caves in Bexar and Comal counties		T
Comal Springs Salamander (*Eurycea* sp. 8) - endemic; Comal Springs		
Edwards Plateau Spring Salamanders (*Eurycea* sp. 7) - endemic; troglobitic; springs, seeps, cave streams, and creek headwaters; often hides under rocks and leaves in water; Edwards Plateau, from near Austin to Val Verde County		
***** BIRDS *****		
American Peregrine Falcon (*Falco peregrinus anatum*) - potential migrant; nests in west Texas	DL	E
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - potential migrant	DL	T
Black-capped Vireo (*Vireo atricapillus*) - oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces; requires foliage reaching to ground level for nesting cover; return to same territory, or one nearby, year after year; deciduous & broad-leaved shrubs & trees provide insects for feeding; species composition less important than presence of adequate broad-leaved shrubs, foliage to ground level, & required structure; nests mid April-late summer	LE	E
Golden-cheeked Warbler *(Dendroica chrysoparia)* juniper-oak woodlands; dependent on Ashe juniper (also known as cedar) for long fine bark strips, only available from mature trees, used in nest construction; nests placed in various trees other than Ashe juniper; only a few mature junipers or nearby cedar brakes can provide the necessary nest material; forage for insects in broad-leaved trees & shrubs; nests late March-early summer	LE	E
Henslow's Sparrow (*Ammodramus henslowii*) – wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking		
Whooping Crane (*Grus americana*) – potential migrant	LE	E
Zone-tailed Hawk (*Buteo albonotatus*) – arid open country, including open deciduous or pine-oak woodland, mesa or mountain county, often near watercourses, and wooded canyons and tree-lined rivers along middle-slopes of desert mountains; nests in various habitats and sites, ranging from small trees in lower desert, giant cottonwoods in riparian areas, to mature conifers in high mountain regions		T
***** CRUSTACEANS *****		
Peck's Cave Amphipod (*Stygobromus pecki*) - small, aquatic crustacean; lives underground in the Edwards Aquifer; collected at Comal Springs and Hueco Springs	LE	

	Federal Status	State Statu
***** FISHES *****		
Fountain Darter (*Etheostoma fonticola*) - known only from the San Marcos and Comal rivers; springs and spring-fed streams in dense beds of aquatic plants growing close to bottom, which is normally mucky; feeding mostly diurnal; spawns year-round with August and late winter to early spring peaks	LE	E
Guadalupe Bass (*Micropterus treculi*) – endemic; headwater, perennial streams of the Edwards Plateau		
***** INSECTS *****		
Comal Springs Dryopid Beetle (*Stygoparnus comalensis*) - dryopids usually cling to objects in a stream; dryopids are sometimes found crawling on stream bottoms or along shores; adults may leave the stream and fly about, especially at night; most dryopid larvae are vermiform and line in soil or decaying wood	LE	
Comal Springs Riffle Beetle (*Heterelmis comalensis*) - Comal and San Marcos Springs	LE	
Edwards Aquifer Diving Beetle (*Haideoporus texanus*) - habitat poorly known; known from an artesian well in Hays County		
***** MAMMALS *****		
Cave Myotis Bat (*Myotis velifer*) – colonial and cave-dwelling; also roosts in rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (*Hirundo pyrrhonota*) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum cave of Panhandle during winter; opportunistic insectivore		
Plains Spotted Skunk (*Spilogale putorius interrupta*) - catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
***** MOLLUSKS *****		
Horseshoe Liptooth (*Polygyra hippocrepis*) – terrestrial snail known only from the steep, wooded hillsides of Landa Park in New Braunfels		
***** REPTILES *****		
Cagle's Map Turtle (*Graptemys caglei*) – endemic; Guadalupe River System; short stretches of shallow water with swift to moderate flow and gravel or cobble bottom, connected by deeper pools with a slower flow rate and a silt or mud bottom; gravel bar riffles and transition areas between riffles and pools especially important in providing insect prey items; nest on gently sloping sand banks within ca. 30 feet of water's edge	C1	
Spot-tailed Earless Lizard (*Holbrookia lacerata*) – central & southern Texas and Adjacent Mexico; oak-juniper woodlands & mesquite-prickly pear associations; eggs laid underground; eats small invertebrates		
Texas Garter Snake (*Thamnophis sirtalis annectens*) - wet or moist microhabitats are conducive to the species occurrence, but is not necessarily restricted to them; hibernates underground or in or under surface cover; breeds March-August		
Texas Horned Lizard (*Phrynosoma cornutum*) - open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September		T

Federal Status | State Statu

*** VASCULAR PLANTS ***

Bracted twistflower (*Streptanthus bracteatus*) – endemic; shallow clay soils over limestone, mostly on rocky slopes, in openings in juniper-oak woodlands; flowering April-May

Canyon mock-orange (*Philadelphus ernestii*) – solution-pitted outcrops of Cretaceous limestone on caprock along mesic canyons, usually in shade of mixed evergreen-deciduous canyon woodland; flowering April-May, fruit maturing in September

Hill country wild-mercury (*Argythamnia aphoroides*) - shallow to moderately deep clays and clay loams over limestone, in grasslands associated with plateau live oak woodlands, mostly on rolling uplands; flowering April-May; fruit persisting until midsummer

Lindheimer's tickseed (*Desmodium lindheimeri*) – known in Texas only from three locations; US habitat is uncertain; has been found along rocky bed of dry ravine and among brush on the banks, steep ravine banks, dry caliche flat roadsides, in shallow soil on outcrops; occurred in deep to partial shade and openings in live oak-juniper woodland associations on the Edward's Limestone; flowering August-October or November.

Texas Mock-orange (*Philadelphus texensis*) – endemic; limestone cliffs and boulders in mesic stream bottoms and canyons, usually in shade of mostly deciduous sloped forest; flowering April-May

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Species appearing on these lists do not all share the same probability of occurrence. Some species are migrants or wintering residents only, or may be historic or considered extirpated.

Notes for County Lists of Texas' Special Species

The Texas Parks and Wildlife (TPWD) county lists **include**:

Vertebrates, Invertebrates, and Vascular Plants on the special species lists of the Texas Biological and Conservation Data System. These special species lists are comprised of all species, subspecies, and varieties that are federally listed; proposed to be federally listed; have federal candidate status; are state listed; or carry a global conservation status indicating a species is imperiled, very rare, or vulnerable to extirpation.

Colonial Waterbird Nesting Areas and Migratory Songbird Fallout Areas are contained on the county lists for coastal counties only.

The TPWD county lists **exclude**:

Natural Plant Communities such as Little Bluestem-Indiangrass Series (native prairie remnant), Water Oak-Willow Oak Series (bottomland hardwood community), Saltgrass-Cordgrass Series (salt or brackish marsh), Sphagnum-Beakrush Series (seepage bog).

Other Significant Features such as non-coastal bird rookeries, migratory bird information, bat roosts, bat caves, invertebrate caves, and prairie dog towns.

The **revised date** on each county list reflects the last date any changes or revisions were made for that county and reflects current listing statuses and taxonomy.

Species that appear on county lists do not all share the same probability of occurrence within a county. Some species are migrants or wintering residents only. Additionally, a few species may be historic or considered extirpated within a county. Species considered extirpated within the state are so flagged on each list.

The Texas Biological and Conservation Data System

The Texas Biological and Conservation Data System (TXBCD), established in 1983, is the state's most comprehensive source of information on rare, threatened, and endangered plants and animals, exemplary natural communities, and other significant features. The TXBCD is constantly updated, providing current information on statewide status and locations of these unique elements of natural diversity.

The TXBCD gathers biological information from museum and herbarium collection records, publications, experts in the scientific community, organizations, individuals, and on-site field surveys conducted by TPWD staff on public lands or private lands with written permission. TPWD staff botanists, zoologists, and ecologists perform field surveys to locate and verify specific occurrences of high-priority biological elements and collect accurate information on their condition, quality, and management needs.

The TXBCD can be used to help evaluate the environmental impact of routing and siting options for development projects. It also assists in impact assessment, environmental review, and permit review.

Given the small proportion of public versus private land in Texas, the TXBCD includes less than a representative inventory of rare resources in the state. Although it is based on the best data available to TPWD regarding rare species, these data cannot provide a definitive statement as to the presence, absence, or condition of special species, natural communities, or other significant features in any area. Nor can these data substitute for on-site evaluation by qualified biologists. The TXBCD information is intended to assist the user in avoiding harm to species that may occur.

Please use the following citation to credit the TXBCD as the source for this county level information:

> Texas Biological and Conservation Data System. Texas Parks and Wildlife, Wildlife Diversity Branch. County Lists of Texas' Special Species. [county name(s) and revised date(s)].

For information on obtaining a project review form or a site-specific review of a project area for rare species, please call (512) 912-7011.

The Environmental Company, Inc.

2496 Old Ivy Road • Suite 300
Mailing Address: P.O. Box 5127
Charlottesville, Virginia 22905
(804) 295-4446 • Fax (804) 295-5535
Internet: www.tecinc.com

July 5, 2001

Mr. Rotary Green
Natural and Cultural Resources Branch
Environmental Division
Fort Sam Houston, Texas

Dear Mr. Green,

RE: Federally Listed Threatened and Endangered Species of Texas

In response to a telephonic request for an updated list of threatened and endangered species in Bexar and Comal Counties, Texas, Ms. Dawn Whitehead of the U. S. Fish and Wildlife Service provided by e-mail the attached Federal threatened and endangered species list for Texas, dated February 13, 2001. I have extracted the general list for Texas and those for Bexar and Comal Counties in particular.

Sincerely,

Craig Vanderhoef
Project Manager

Attachment:
Federal Threatened and Endangered Species List

Vanderhoef, Craig

From: Dawn_Whitehead@fws.gov
Sent: Tuesday, July 3, 2001 2:56 PM
To: ctvanderhoef@tecinc.com
Subject: County by County Species Lists

cobyco13feb01.wpd

Here are the County by County Species Lists for Texas. You may use the Bexar and Comal lists for your EA on Fort Sam Houston. Please be aware that if you do not complete the EA in 3-6, months you should check back with us as the information may become "stale" and require updating.
(See attached file: cobyco13feb01.wpd)

Dawn Whitehead
(512) 490-0057

Federally Listed as Threatened and Endangered Species of Texas

February 13, 2001

This list represents species that may be found in counties throughout the state. It is recommended that the field station responsible for a project area be contacted if additional information is needed (see enclosed map).

DISCLAIMER

This County by County list is based on information available to the U.S. Fish and Wildlife Service at the time of preparation, date on page 1. This list is subject to change, without notice, as new biological information is gathered and should not be used as the sole source for identifying species that may be impacted by a project.

Edwards Aquifer species: (Edwards Aquifer County) refers to those six counties within the Edwards Aquifer region. The Edwards Aquifer underlies portions of Kinney, Uvalde, Medina, Bexar, Hays, and Comal Counties (Texas). The Service has expressed concern that the combined current level of water withdrawal for all consumers from the Edwards Aquifer adversely affects aquifer-dependent species located at Comal and San Marcos springs during low flows. Deterioration of water quality and/or water withdrawal from the Edwards Aquifer may adversely affect eight federally-listed species.

Comal Springs riffle beetle	(E)	*Heterelmis comalensis*
Comal Springs dryopid beetle	(E)	*Stygoparnus comalensis*
Fountain darter	(E w/CH)	*Etheostoma fonticola*
Peck's cave amphipod	(E)	*Stygobromus (=Stygonectes) pecki*
San Marcos gambusia	(E w/CH)	*Gambusia georgei*
Texas wild-rice	(E w/CH)	*Zizania texana*
Texas blind salamander	(E)	*Typhlomolge rathbuni*
San Marcos salamander	(T □w/CH)	*Eurycea nana*

* The Barton Springs salamander is found in Travis County but may be affected by activities within the Barton Springs Segment of the Edwards Aquifer, which includes portions of Northern Hays County.

Migratory Species Common to many or all Counties: Species listed specifically in a county have confirmed sightings. If a species is not listed they may occur as migrants in those counties.

Least tern	(E ~)	*Sterna antillarum*
Whooping crane	(E w/CH)	*Grus americana*
Bald eagle	(T)	*Haliaeetus leucocephalus*
Piping plover	(T w/P/CH)	*Charadrius melodus*
Loggerhead shrike	(SOC)	*Lanius ludovicianus*
White-faced ibis	(SOC)	*Plegadis chihi*

Bexar County (Edwards Aquifer County)

Black-capped vireo	(E)	*Vireo atricapillus*
Golden-cheeked warbler	(E)	*Dendroica chrysoparia*
Madla's cave meshweaver	(E)	*Cicurina madla*

Robber Baron Cave meshweaver	(E)	*Cicurina baronia*
Braken Bat Cave meshweaver	(E)	*Cicurina venii*
Government Canyon Bat Cave meshweaver	(E)	*Cicurina vespera*
Government Canyon Bat Cave spider	(E)	*Neoleptoneta microps*
Cokendolpher cave harvestmen	(E)	*Texella cokendolpheri*
Ground beetle (no common name)	(E)	*Rhadine exilis*
Ground beetle (no common name)	(E)	*Rhadine infernalis*
Helotes mold beetle	(E)	*Batrisodes venyivi*
Mountain plover	(P/T)	*Charadrius montanus*
Ferruginous hawk	(SOC)	*Buteo regalis*
Loggerhead shrike	(SOC)	*Lanius ludovicianus*
Mexican hooded oriole	(SOC)	*Icterus cucullatus cucullatus*
Reddish egret	(SOC)	*Egretta rufescens*
Texas garter snake	(SOC)	*Thamnophis sirtalis annectans*
Texas horned lizard	(SOC)	*Phrynosoma cornutum*
Comal blind salamander	(SOC)	*Eurycea tridentifera*
Texas salamander	(SOC)	*Eurycea neotenes*
Big red sage	(SOC)	*Salvia penstemonoides*
Correll's false dragon-head	(SOC)	*Physostegia correllii*
Toothless blindcat	(SOC)	*Trogloglanis pattersoni*
Widemouth blindcat	(SOC)	*Satan eurystomus*
Maculated manfreda skipper	(SOC)	*Stallingsia maculosus*
Mimic cavesnail	(SOC)	*Phreatodrobia imitata*

Comal County (Edwards Aquifer County)

Black-capped vireo	(E)	*Vireo atricapillus*
Golden-cheeked warbler	(E)	*Dendroica chrysoparia*
Fountain darter	(E w/CH)	*Etheostoma fonticola*
Comal Springs riffle beetle	(E)	*Heterelmis comalensis*
Comal Springs dryopid beetle	(E)	*Stygoparnus comalensis*
Peck's cave amphipod	(E)	*Stygobromus (=Stygonectes) pecki*
Cagle's map turtle	(C)	*Graptemys caglei*
Loggerhead shrike	(SOC)	*Lanius ludovicianus*
Comal blind salamander	(SOC)	*Eurycea tridentifera*
Texas salamander	(SOC)	*Eurycea neotenes*
Texas horned lizard	(SOC)	*Phrynosoma cornutum*
Bracted twistflower	(SOC)	*Streptanthus bracteatus*
Canyon mock orange	(SOC)	*Philadelphus ernestii*
Comal snakewood	(SOC)	*Colubrina stricta*
Glass Mountain coral-root	(SOC)	*Hexalectris nitida*
Hill Country wild mercury	(SOC)	*Argythamnia aphoroides*
Texas cave diving beetle	(SOC)	*Haideoporus texanus*
Horseshoe liptooth (snail)	(SOC)	*Polygyra hippocrepsis*

INDEX

Statewide or areawide migrants are not included by county, except where they breed or occur in concentrations. The whooping crane is an exception; an attempt is made to include all confirmed sightings on this list.

E	=	Species in danger of extinction throughout all or a significant portion of its range.
T	=	Species which is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.
C	=	Species for which the Service has on file enough substantial information to warrant listing as threatened or endangered.
CH	=	Critical Habitat (in Texas unless annotated ‡)
P/	=	Proposed ...
P/E	=	Species proposed to be listed as endangered.
P/T	=	Species proposed to be listed as threatened.
TSA	=	Threatened due to similarity of appearance.
SOC	=	Species for which there is some information showing evidence of vulnerability, but not enough data to support listing at this time.
□	=	with special rule
‡	=	CH designated (or proposed) outside Texas
~	=	protection restricted to populations found in the "interior" of the United States. In Texas, the least tern receives full protection, except within 50 miles (80 km) of the Gulf Coast.

County Name Code Designations:

examples

Anderson	=	Arlington Ecological Services (ES) office
(Bee)	=	Corpus Christi ES office
[Galveston]	=	Clear Lake ES office
Gillespie	=	Austin ES office